PROJECT TITLE: Evaluation of malt barley varieties under irrigated and dryland conditions – 2009 (4W2756)

PRINCIPAL INVESTIGATOR:
Tom Blake, MSU Dept Plant Sciences
Personnel:
Stan Bates, MSU Dept Plant Sciences
Joyce Eckhoff, Eastern Ag Research Center, 1501 N Central Ave, Sidney, MT 59270

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

Methods:
Dryland site:
Planted: April 20 Harvested: August 28
Soil type: Williams clay loam
Previous crops: 2008 - fallow, 2007 – safflower, 2006 - small grain plots
Residual soil N to 3 ft: 95 lb N/ac
Residual soil P to 6 in: 31 ppm
Applied fertilizer: none
Herbicides: Brox M, 1.5 pt/ac, applied June 3
Precipitation April – August, 2009: 8.87 in
Ave (60 yr) precipitation April – August: 9.41 in
Precipitation September 2008 – August 2009: 13.93 in
Ave (60 yr) precipitation September – August: 13.82 in

Irrigated:
Planted: May 5 Harvested: August 29
Soil type: Savage silty clay
Previous crops: 2008 – safflower, 2007 – sugarbeet, 2006 – small grain
Residual soil N to 3 ft: 75 lb N/ac
Residual soil P to 6 in: 15 ppm
Applied fertilizer: 200 lb/ac 18-46-0, and 50 lb liquid N/ac, applied in November, 2008
Irrigated (sprinkler) on: May 22, June 17, July 24, 1 inch each application
Herbicides: Brox-M at a rate of 1.5 pt/ac, applied June 2

Precipitation April – August, 2009: 10.45 in
Ave (60 yr) precipitation April – August: 9.41 in
Precipitation September 2008 – August 2009: 15.77 in
Ave (60 yr) precipitation September – August: 13.82 in

Comments:
It was generally a cool summer. Soil moisture was good at planting, but conditions were very dry in May and June. Rain started in early July, causing secondary tillering.

RESULTS:
Dryland: Agronomic data from the dryland malt barley yield trial are shown in Table 1. Fourteen lines and varieties yielded significantly more than the check variety, Haxby. 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. Eight lines and varieties yielded significantly less than the check variety, Haxby. Five-year summaries of yield, test weight, protein contents, percent plump, and lodging indices are shown in Tables 7-11.

SUMMARY: In a spring wheat yield trial, 14 lines and varieties yielded significantly more than the check variety, Haxby. In an irrigated trial, 8 lines and varieties yielded significantly less than the check variety, Haxby.

FUNDING SUMMARY: Expenditure information to be provided by OSP. No other grants support this project.

MWBC FY2011 GRANT SUBMISSION PLANS: It is planned to submit this project for funding consideration in the next fiscal year.

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*	heignt, cm	grain protein	test wt, lb/bu	% plump	% regular	yield, bu/ac	
Pinnacle	62.7	53.7	11.80	50.2	98.7	1.3	61.9	a
MT030042	63.3	47.7	12.79	52.0	97.0	2.7	60.0	a
Champion	65.3	56.7	12.66	50.7	97.0	2.7	59.2	a
Baronesse	65.3	48.0	13.74	51.0	96.0	4.0	58.9	a
MT061207	63.0	54.0	13.30	50.3	98.0	1.7	58.6	a
Gallatin	63.3	52.3	13.60	51.0	94.7	5.0	56.7	a
MT010158	64.7	46.7	13.09	49.2	94.0	5.7	53.0	a
MT020155	61.0	53.3	13.63	50.2	93.7	6.0	50.7	a
Geraldine	65.7	43.7	13.20	48.7	91.3	8.3	49.5	a
Hockett	61.3	52.0	13.99	50.2	93.7	5.0	48.7	a
Metcalfe	62.7	51.3	14.19	50.0	97.0	3.0	47.7	a
Conrad	64.3	44.7	13.00	49.8	95.3	4.3	47.7	a
Harrington	63.3	47.0	14.43	49.0	94.7	4.7	47.1	a
Goldeneye	60.3	47.3	12.77	48.5	90.3	9.3	47.0	a
Craft	63.3	57.7	14.48	51.2	97.7	2.3	42.1	
Haxby	62.0	50.0	14.47	51.5	96.0	3.7	39.4	
Average	63.2	50.4	13.45	50.2	95.3	4.4	51.8	
probability	<0.001	<0.001	0.176	<0.001	0.035	0.011	<0.001	
CV (S/mean)	1.7	7.0	8.1	1.6	2.9	54.9	7.3	
CV (SE/mean)	1.0	4.0	4.7	0.9	1.7	31.7	4.2	
LSD (0.05)	1.7	5.9	1.82	1.3	4.6	4.0	6.3	

*days from planting
a indicates significantly greater yield than check variety, Haxby

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

Variety	2005	2006	2007	2008	2009	Ave	as % of Haxby
MT030042	--	--	--	--	60.0	60.0	152.3
Baronesse	--	--	--	--	59.8	59.8	151.8
MT061207	--	--	--	--	58.6	58.6	148.7
Gallatin	--	--	--	--	56.7	56.7	143.9
Champion	--	--	--	66.9	59.2	63.1	123.3
Goldeneye	--	--	--	--	47.0	47.0	119.3
MT010158	--	--	--	64.4	53.0	58.7	114.8
MT020155	--	--	--	65.4	50.7	58.1	113.5
Pinnacle	--	--	--	52.8	61.9	57.4	112.1
Conrad	77.8	82.3	86.7	60.5	47.7	71.0	103.6
Geraldine	75.2	76.4	81.8	60.6	49.5	68.7	100.2
Haxby	84.5	81.1	74.8	62.9	39.4	68.5	100.0
Craft	76.4	90.9	67.0	57.8	42.1	66.8	97.5
Metcalfe	74.5	85.8	75.3	49.6	47.7	66.6	97.1
Hockett	72.7	81.6	67.8	57.1	48.7	65.6	95.7
Harrington	74.7	73.5	71.8	54.2	47.1	64.3	93.8

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 Haxby when grown under dryland conditions at the EARC, Sidney, Montana.

Variety	2005	2006	2007	2008	2009	Ave	as % of Haxby
MT030042	--	--	--	--	52.0	52.0	101.0
Haxby	50.3	53.0	52.0	50.2	51.5	51.4	100.0
Baronesse	--	--	--	--	51.0	51.0	99.0
Gallatin	--	--	--	--	51.0	51.0	99.0
Craft	50.7	50.8	51.3	47.3	51.2	50.3	97.8
MT061207	--	--	--	--	50.3	50.3	97.7
Hockett	50.0	50.8	50.7	47.0	50.2	49.7	96.8
MT020155	--	--	--	47.7	50.2	49.0	96.3
Pinnacle	--	--	--	47.7	50.2	49.0	96.3
Champion	--	--	--	46.8	50.7	48.8	95.9
Metcalfe	47.7	50.5	50.2	45.5	50.0	48.8	94.9
MT010158	--	--	--	47.0	49.2	48.1	94.6
Goldeneye	--	--	--	--	48.5	48.5	94.2
Conrad	47.8	48.7	50.0	45.7	49.8	48.4	94.2
Geraldine	49.7	48.0	50.7	44.8	48.7	48.4	94.1
Harrington	45.8	46.8	50.0	44.5	49.0	47.2	91.9

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 Haxby when grown under dryland conditions at the EARC, Sidney, Montana.

Variety	2005	2006	2007	2008	2009	Ave	as % of Haxby
Haxby	10.7	12.8	13.0	14.7	14.5	13.1	100.0
Craft	11.0	13.3	12.4	14.3	14.5	13.1	99.7
Metcalfe	10.5	12.2	11.1	16.0	14.2	12.8	97.4
Conrad	9.8	12.3	11.9	16.1	13.0	12.6	96.0
Geraldine	10.2	12.2	10.9	15.9	13.2	12.5	95.0
Baronesse	--	--	--	--	13.7	13.7	94.5
Harrington	10.1	11.8	10.5	15.0	14.4	12.4	94.1
Gallatin	--	--	--	--	13.6	13.6	93.8
Hockett	9.7	11.3	11.3	14.4	14.0	12.1	92.4
MT061207	--	--	--	--	13.3	13.3	91.7
MT010158	--	--	--	13.6	13.1	13.4	91.4
MT020155	--	--	--	13.0	13.6	13.3	91.1
Champion	--	--	--	13.1	12.7	12.9	88.4
MT030042	--	--	--	--	12.8	12.8	88.3
Goldeneye	--	--	--	--	12.8	12.8	88.3
Pinnacle	--	--	--	13.6	11.8	12.7	87.0

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 Haxby when grown under dryland conditions at the EARC, Sidney, Montana.

Variety	2005	2006	2007	2008	2009	Ave	as % of Haxby
Pinnacle	--	--	--	74	99	86.5	121.0
Craft	89	84	89	66	98	85.2	111.2
Hockett	94	87	88	55	94	83.6	109.1
Metcalfe	88	89	87	47	97	81.6	106.5
Conrad	92	81	88	43	95	79.8	104.2
MT020155	--	--	--	54	94	74.0	103.5
MT010158	--	--	--	54	94	74.0	103.5
Harrington	86	74	89	49	95	78.6	102.6
MT061207	--	--	--	--	98	98.0	102.1
Champion	--	--	--	48	97	72.5	101.4
MT030042	--	--	--	--	97	97.0	101.0
Haxby	85	73	82	47	96	76.6	100.0
Baronesse	--	--	--	--	96	96.0	100.0
Gallatin	--	--	--	--	95	95.0	99.0
Goldeneye	--	--	--	--	90	90.0	93.8
Geraldine	80	60	76	37	91	68.8	89.8

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 flood irrigated conditions at the Eastern Agricultural Research Center, Sidney, Montana.

entry	heading*	height, cm	lodging index	grain protein %	test wt, lb/bu	% plump	% regular	yield, bu/ac	
Haxby	51.7	77.3	2.0	13.30	52.2	92.0	6.0	148.0	
Champion	51.7	80.7	0.7	13.23	51.3	89.7	9.0	143.5	
Pinnacle	51.0	77.3	0.0	10.98	50.8	93.7	5.3	142.6	
Craft	51.7	79.3	1.8	13.24	52.0	90.7	7.0	139.6	
Metcalfe	52.0	81.7	2.3	12.39	50.8	91.3	7.3	138.2	
MT061207	51.0	71.7	1.0	13.21	51.0	92.3	6.3	137.2	
Goldeneye	49.3	70.3	3.7	10.97	48.8	86.7	11.7	136.7	
Geraldine	54.3	73.3	0.3	12.05	51.3	91.7	6.0	136.7	
MT020155	48.0	76.0	1.3	12.14	49.0	87.7	10.7	133.3	x
Harrington	54.0	76.3	4.5	12.90	49.3	84.0	11.7	131.3	x
Conrad	52.7	66.7	2.0	13.73	50.2	87.7	9.3	129.7	x
Gallatin	50.3	77.0	2.5	12.47	51.2	86.7	10.3	127.1	x
Baronesse	53.7	77.0	2.2	13.00	50.0	89.3	8.3	126.8	x
Hockett	51.0	77.3	3.7	12.98	50.0	88.0	8.7	126.2	x
MT030042	50.3	68.7	2.3	13.08	50.0	84.3	13.3	125.4	x
MT010158	51.0	72.7	1.0	11.00	50.0	93.0	5.3	122.7	x
Average	51.5	75.2	2.0	12.54	50.5	89.3	8.5	134.1	
probability	<0.001	0.002	0.001	0.090	<0.001	0.169	0.042	0.004	
CV (S/mean)	1.4	5.3	58.0	9.3	1.2	4.8	35.3	5.5	
CV (SE/mean)	0.8	3.0	33.5	5.4	0.7	2.7	20.4	3.2	
LSD (0.05)	1.2	6.6	1.9	1.95	1.0	7.1	5.0	12.3	

*days from planting
x indicates significantly lower yield than check variety, Haxby

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

Cultivar	2005	2006	2007	2008	2009	Ave	as % of Haxby
Champion	--	--	--	150.9	143.5	147.2	109.0
Geraldine	128.5	98.8	56.8	139.4	136.7	112.0	102.3
Conrad	129.3	109.2	62.0	119.4	129.7	109.9	100.4
Haxby	120.8	97.6	59.0	122.1	148.0	109.5	100.0
Craft	113.5	99.9	59.6	123.7	139.6	107.3	98.0
Hockett	115.0	98.9	52.1	132.5	126.2	104.9	95.8
Metcalfe	120.8	94.1	52.0	115.2	138.2	104.1	95.0
MT020155	--	--	--	122.4	133.3	127.9	94.7
Pinnacle	--	--	--	109.1	142.6	125.9	93.2
MT061207	--	--	--	--	137.2	137.2	92.7
Goldeneye	--	--	--	--	136.7	136.7	92.4
Harrington	97.2	93.5	67.2	110.0	131.3	99.8	91.2
MT010158	--	--	--	120.9	122.7	121.8	90.2
Gallatin	--	--	--	--	127.1	127.1	85.9
Baronesse	--	--	--	--	126.8	126.8	85.7
MT030042	--	--	--	--	125.4	125.4	84.7

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 damage in 2007.

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

Cultivar	2005	2006	2007	2008	2009	Ave	as % of Haxby
Haxby	51.2	49.8	49.5	54.3	52.2	51.4	100.0
Craft	50.7	50.2	49.0	53.3	52.0	51.0	99.3
Geraldine	50.8	48.0	49.2	53.2	51.3	50.5	98.2
Champion	--	--	--	53.2	51.3	52.3	98.1
Gallatin	--	--	--	--	51.2	51.2	98.1
MT061207	--	--	--	--	51.0	51.0	97.7
Pinnacle	--	--	--	53.0	50.8	51.9	97.5
Conrad	51.0	48.8	46.8	51.7	50.2	49.7	96.7
Metcalfe	50.2	47.8	47.3	51.8	50.8	49.6	96.5
Hockett	50.8	48.3	46.5	52.2	50.0	49.6	96.4
Baronesse	--	--	--	--	50.0	50.0	95.8
MT030042	--	--	--	--	50.0	50.0	95.8
MT010158	--	--	--	51.7	50.0	50.9	95.5
MT020155	--	--	--	52.5	49.0	50.8	95.3
Harrington	47.0	47.7	47.3	51.0	49.3	48.5	94.3
Goldeneye	--	--	--	--	48.8	48.8	93.5

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 damage in 2007.

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

Cultivar	2005	2006	2007	2008	2009	Ave	as % of Haxby
Craft	14.2	13.2	13.4	12.7	13.2	13.3	104.4
Conrad	13.3	12.4	13.2	11.5	13.7	12.8	100.3
Haxby	14.0	12.0	12.4	12.2	13.3	12.8	100.0
MT061207	--	--	--	--	13.2	13.2	99.2
MT030042	--	--	--	--	13.1	13.1	98.5
Geraldine	13.3	11.8	13.3	12.3	12.0	12.5	98.1
Baronesse	--	--	--	--	13.0	13.0	97.7
Metcalfe	12.8	12.2	13.1	11.3	12.4	12.4	96.7
Champion	--	--	--	11.4	13.2	12.3	96.5
Hockett	13.2	10.9	11.9	12.1	13.0	12.2	95.6
Harrington	12.7	11.0	12.6	11.4	12.9	12.1	94.8
Gallatin	--	--	--	--	12.5	12.5	94.0
MT010158	--	--	--	11.5	11.0	11.3	88.2
MT020155	--	--	--	10.1	12.1	11.1	87.1
Pinnacle	--	--	--	10.4	11.0	10.7	83.9
Goldeneye	--	--	--	--	11.0	11.0	82.7

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 damage in 2007.

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

Cultivar	2005	2006	2007	2008	2009	Ave	as % of Haxby
Conrad	95	89	87	93	88	90.4	104.1
Metcalfe	94	87	84	92	91	89.6	103.2
Craft	92	86	84	94	91	89.4	103.0
Pinnacle	--	--	--	96	94	95.0	102.2
Hockett	95	87	81	91	88	88.4	101.8
Haxby	91	76	81	94	92	86.8	100.0
MT061207	--	--	--	--	92	92.0	100.0
Harrington	85	90	83	89	84	86.2	99.3
Champion	--	--	--	94	90	92.0	98.9
MT010158	--	--	--	91	93	92.0	98.9
Geraldine	84	79	81	92	92	85.6	98.6
MT020155	--	--	--	94	88	91.0	97.8
Baronesse	--	--	--	--	89	89.0	96.7
Goldeneye	--	--	--	--	87	87.0	94.6
Gallatin	--	--	--	--	87	87.0	94.6
MT030042	--	--	--	--	84	84.0	91.3

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 damage in 2007.

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

Cultivar	2005	2006	2007	2008	2009	Ave	as % of Haxby
Harrington	6.0	0.3	0.0	0.3	4.5	2.2	482.6
Hockett	0.3	0.0	0.0	0.7	3.7	0.9	204.3
Goldeneye	--	--	--	--	3.7	3.7	185.0
Craft	1.3	0.7	0.0	0.3	1.8	0.8	178.3
MT010158	--	--	--	2.0	1.0	1.5	150.0
Gallatin	--	--	--	--	2.5	2.5	125.0
MT030042	--	--	--	--	2.3	2.3	115.0
Conrad	0.3	0.0	0.0	0.3	2.0	0.5	113.0
Metcalfe	0.3	0.0	0.0	0.0	2.3	0.5	113.0
Baronesse	--	--	--	--	2.2	2.2	110.0
Haxby	0.0	0.3	0.0	0.0	2.0	0.5	100.0
MT020155	--	--	--	0.7	1.3	1.0	100.0
Geraldine	0.7	0.0	0.0	0.3	0.3	0.3	56.5
Champion	--	--	--	0.3	0.7	0.5	50.0
MT061207	--	--	--	--	1.0	1.0	50.0
Pinnacle	--	--	--	0.0	0.0	0.0	0.0

NOTE: Average lodging indices 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 damage in 2007.