

# MT910189 (Hockett): The Next Harrington? Western Two-Row

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## Introduction

Much of Western North America was a grassland prior to the arrival of settlers. Montana retains an excellent environment for production of barley and wheat. Barley, especially 2-rowed spring barley, fits well into this variable and unpredictable habitat thanks to its ability to adjust its number of tillers, spikes and seeds per spike based on the availability of moisture and nutrients.

Since Bob Eslick identified Betzes (1946), Montana has awaited the arrival of a new, high yielding, reliable dryland malting barley variety. Betzes, a land race accession from Eastern Europe, brought new levels of prosperity to Montana farmers. Well-adapted to Montana production conditions and as high yielding as Compana, its unmaltable but durable predecessor, Betzes and its descendant, Klages, are still remembered by Western barley growers.

Harrington became the dominant 2-rowed malting barley grown in Western North America, but its late flowering and maturation render it susceptible to the effects of late season moisture deficit common in Montana and Western North Dakota. Every barley improvement program in Western North America has released 2-rowed varieties that surpass Harrington's agronomic performance and reliability. Matching Harrington's processing speed, extract and enzyme activity has not been as easy. In this report, we demonstrate that MT910189 exceeds Harrington's agronomic capabilities, more reliably can be expected to meet malting barley specifications than Harrington when grown on dryland, and is equal to or better than Harrington in malting quality.

## Materials and Methods

### 1. Agronomic Evaluation

The Montana Agricultural Experiment station maintains seven major crop evaluation research centers in key locations around the state. Bozeman, Conrad, Kalispell, Havre, Sidney, Moccasin and Huntley provide crop performance data under both dryland and irrigated conditions for Montana's farming community. Our statewide intrastate trial is the culmination of line evaluation prior to the decision to release new varieties, and to recommend varieties entered by colleagues and private companies. We tabulate replicated yield trial data from six dryland and five irrigated locations per year, each experiment consisting of a 64 entry lattice-design nursery with three replications. Each plot consists of 4 x 4 meter long rows, each row spaced 0.3m apart. Results from these experiments are compiled and released in the MAES Feed Crops Report each year.

Two of these trials per year are submitted to the USDA-CCRU for quality evaluation. Malting data from these trials is provided is compiled and combined with agronomic performance datasets.. Following 3 or more years of successful micromalting results, up to three lines may be entered into the AMBA-sponsored pilot scale evaluation

program. These lines are invariably agronomically improved relative to common malting barley varieties, and show potential malting excellence.

## Results

MT910189 showed consistent agronomic superiority to Harrington, and was the equal of the most widely-grown feed barley variety, Gallatin, across Montana. This line exhibited superior drought avoidance, most likely by heading and maturing earlier than Harrington, indicated in tables 1 and 2. Increased kernel weight and plumpness, and enhanced malting quality were direct results of this combination of Harrington-like malt quality genes with the ability to develop plump and well-filled grain prior to terminal drought. Malt quality analyses provided by the USDA-Madison CCRU are shown in table 3. These data show both the Harrington-like nature of MT910189 malt and the value of increased kernel plumpness in improving extract.

These data encouraged us to enter MT910189 in the AMBA-sponsored Pilot Scale Evaluations (Table 4a). Pilot-scale tests demonstrated the equivalence or superiority of MT910189 to Harrington, and resulted in the favorable rating given by the evaluators to MT910189 in both 1997 and 1998. The USDA-managed Western Regional Nurseries likewise confirmed the malting quality potential of this line (Table 4b). Earliness to flower is only an advantage when avoidance of terminal drought, heat or disease is desirable. While this is generally the case in Western Montana, it is not the norm in California, much of Oregon or Washington. The yield advantage of MT910189 over Harrington will most commonly be observed in environments like Montana's Golden Triangle.

Risk management is central to profitable farming, malting and brewing. Reducing risk of failure at each level reduces costs to both producer and purchaser, resulting in increased efficiency. The most common symptom of failure for barley producers is thin, high protein grain. MT910189 will significantly reduce risk for dryland barley growers in rainfed production areas of Montana by reducing the frequency with which thin, high protein grain is harvested, relative to Harrington (Table 5).

Variety	# locs	Yield bu/ac	# locs	Test Weight lb/bu	# locs	Plump Percent	# locs	Heading Date	# locs	Plant Height inches	# locs	Protein Percent
Harrington MT91018	93	87.8	92	49.1	92	73.2	87	179.9	91	29.7	89	13.1
9	93	91.0	92	51.2	92	80.7	87	176.7	91	28.9	89	12.7
Gallatin	93	90.4	92	51.1	92	71.4	87	177.5	91	30.7	89	13.0

Table 1. Agronomic performance of MT910189, contrasted with Harrington and Gallatin across Montana 1994-2003

When Rainfed locations were considered, and terminal drought permitted to play its normal role, the advantage held by MT910189 became more obvious.

Table 2. Agronomic performance on Dryland locations, 1994-2003 (45 experiments)

Location	MT910189	Harrington	Gallatin
Yield (bu/ac)	66.1	62.0	65.3
Plump	74.4	65.2	63.6
Protein	13.0	13.6	13.5
Test Weight	49.5	47.1	48.8

Lab No.	Selection	Kernel Weight (mg)	Kernel Color (%)	Barley Color (Agtron)	Malt Extract (%)	Wort Color	Wort Clarity	Barley Protein (%)	Wort Protein (%)	S/T (%)	DP (°ASBC)	Alpha-amylase (20°DU)	Beta-glucan (ppm)	Overall Rank
Boz Irr	Harrington	35.1	76.4	81	80.7	1.3	1	12.2	5.44	47.8	110	63.4	183	9

2003	MT91018 9	44.4	93.0	80	81.7	1.6	1	11.5	5.95	52.8	114	68.4	130	6
Boz Irr	Harrington	37.0	75.6	73	80.0	1.4	2	11.7	4.86	44.1	108	59.6	267	11
2000	MT91018 9	45.4	90.9	72	79.5	1.4	1	12.1	4.92	42.4	117	61.5	365	7
Conrad Irr.	Harrington	37.2	87.9	81	80.0	1.3	2	11.6	4.91	44.4	119	48.0	474	4
2000	MT91018 9	44.8	95.6	81	81.5	1.4	1	10.7	4.94	46.9	134	54.5	145	2
Boz. Irr	Harrington	37.0	77.6	55	78.6	1.6	1	14.5	5.36	38.3	159	51.3	573	19
1997	MT91018 9	44.7	90.8	58	79.1	1.2	2	13.0	4.74	35.6	153	47.6	714	12
Boz Irr.	Harrington	35.6	87.8	70	79.0	1.7	1	14.1	5.64	41.2	189	63.5	82	16
1998	MT91018 9	37.2	83.9	74	78.8	1.6	1	13.6	5.60	43.2	193	65.9	88	17
Boz Irr	Harrington	37.7	86.1	68	79.9	1.4	2	14.3	5.62	39.2	171	65.5	332	18
1999	MT91018 9	41.8	80.9	72	78.5	1.4	1	14.5	5.24	34.9	179	64.2	412	19
Sidney Irr	Harrington	42.8	90.9	57	81.4	1.5	2	11.8	5.06	43.6	129	49.2	421	1
1999	MT91018 9	46.2	93.9	56	82.0	1.6	1	11.4	5.20	44.5	134	53.1	467	3
Conrad Irr	Harrington	41.1	93.0	55	81.1	1.6	1	12.0	5.07	42.5	123	78.0	437	4
1999	MT91018 9	46.8	97.4	48	81.7	1.7	1	11.7	5.06	45.1	131	78.4	523	7
Sidney Offstation	Harrington	36.0	72.6	60	80.5	1.7	1	11.9	5.01	44.4	94	71.2	298	12
1999	MT91018 9	39.9	82.2	62	81.0	1.9	1	12.1	5.26	46.0	105	67.7	326	14
Kalispell Offstation	Harrington	41.5	96.5	37	78.4	2.0	2	13.5	4.99	37.6	93	71.2	377	15
1999	MT91018 9	45.4	97.1	35	79.7	1.7	1	13.1	5.26	41.1	113	79.0	391	10

Avg.	Harrington	38.1	84.4	64	80.0	1.5	2	12.8	5.20	42.6	130	62.1	344	10.9
1997-2003	MT91018	43.6	90.6	64	80.3	1.5	1	12.4	5.12	43.3	137	64.0	356	9.7

Table 3. Malt Quality Comparison, Harrington vs. MT910189, 1997-2003.

Table 4a.  
AMBA Pilot Trials

Variety of Selection	1997		1998	
	MT910189	Harrington-MT	MT910189	Harrington-MT
On 7/64 (%)	90.5	77.2	51.1	41.2
Extract, Fine Grind (% d.b.)	81.4	80.8	80.9	80.4
Carbohydrate Extract^ (% d.b.)	76.3	75.7	76.1	74.9
Extract Constant^	89.8	88.8	87.6	87.5
F-C Difference	1.5	1.5	1.3	1.8
Wort Viscosity	1.49	1.42	1.42	1.41
Wort Color (Deg. Lov.)	1.57	1.71	1.50	1.72
Wort Turbidity (Hach NTU)	4.0	4.6	6.5	7.7
Diastatic Power* (Deg. L)	145	141	123	135
DP/Total Protein^	12.3	12.6	11.6	12.1
Alpha Amylase* (D.U.)	62.2	66.2	62.1	62.9
Soluble Protein (% d.b.)	5.09	5.06	4.75	5.50
Total Protein (% d.b.)	11.78	11.22	10.58	11.16
Soluble/Total Protein (% d.b.)	43.3	45.1	44.7	49.6
Beta-Glucan (ppm)	308	175	151	118

MT910189 yields about the same as the feed variety Gallatin. Further data will be provided by breeder. Little plumper and higher test weight than Harrington.

Wide adaptation with reasonable performance on dryland.

This line was advanced to plant scale after 1998 crop pilot testing. Seed for plant scale tests was grown in 2000, but the drought limited production and quality. For some reason, continued plant scale trials were not pursued.

Table 4b.

**Western Reginal Nursery 1998-200 Averages**

		Harrington	MT910189
on 6/64	(%)	81.9	93.4
Color	(Agtron)	64.1	64.9
Extract, Fine Grind	(% d.b.)	78.9	80.6
Total Protein	(% d.b.)	13.3	12.6
Soluble Protein	(% d.b.)	4.95	5
Soluble/Total Protein	(% d.b.)	38.5	42.0
Diastatic Power*	(Deg. L)	121	140
Alpha Amylase*	(D.U.)	60.9	69.4
Beta-Glucan	(ppm)	411	358.6
Yield bu/a	(bu/a)	110.2	109.6
Test Wt. lb/bu	(lb/bu)	51.4	52.9

Table 5. The Author's estimate of producers' risk based on dryland production experiments, 1994-2003

Year	Plump Percent Location	Gallatin			Protein%			Maltable?	
		MT910189	Harrington	Gallatin	MT910189	Harrington	Gallatin	MT910189	Harrington
2003	Havre	61.2	53.5	36.9	17.3	19.2	19.2	No	No
	Sidney	73.0	78.0	60.0	13.2	13.0	12.9	Maybe (screened)	Maybe (screened)
	Huntley	76.9	55.6	42.9	19.1	21.5	19.7	No	No
	Conrad	60.0	54.0	25.0	18.8	18.5	19.4	No	No
2002	Havre	89.6	88.7	79.6	15.8	16.3	16.5	Maybe	No
	Sidney	79.0	70.0	80.0	16.5	16.6	16.6	No	No
	Moccasin	60.1	64.4	60.0	12.4	14.1	12.6	Maybe (screened)	Maybe (screened)
	Huntley	0.4	0.9	0.1	14.5	14.5	14.3	No	No
2001	Conrad	97.0	97.0	79.0	18.8	18.8	18.5	No	No
	Havre	76.1	86.9	82.7	12.5	12.7	12.8	Maybe (screened)	Yes
	Sidney	79.0	83.0	76.0	16.8	17.8	17.2	Maybe (screened)	Maybe (screened)
	Moccasin	21.1	25.8	15.5	13.0	14.0	13.9	No	No
2000	Huntley	95.7	94.5	85.8	17.9	17.8	18.6	No	No
	Conrad	82.0	75.0	67.0	14.5	14.2	13.3	Maybe	Maybe (screened)
	Havre	51.3	26.1	23.1	15.6	16.4	15.6	Maybe (screened)	No
	Sidney	96.0	93.0	86.0	15.4	15.7	16.5	Maybe	Maybe
2000	Huntley	92.9	80.4	65.8	11.3	11.5	11.9	Yes	Maybe
	Conrad	45.0	51.0	40.0	14.5	16.7	16.1	No	No

1999	Havre	95.3	85.6	90.0	13.5	14.5	15.2	Yes	Maybe
	Sidney	96.0	94.0	95.0	12.9	12.8	13.7	Yes	Yes
	Moccasin	90.1	74.6	81.3	9.0	9.0	9.3	Yes	No
	Huntley	42.8	17.5	19.9	11.8	12.7	12.0	No	No
	Conrad	98.0	88.0	93.0	16.3	17.4	17.3	Maybe (screened)	Maybe (screened)
1998	Havre	69.4	38.1	43.2	10.1	10.0	10.7	Maybe (screened)	No
	Sidney	85.0	62.0	64.0	12.0	13.6	13.1	Yes	No
	Moccasin	62.8	30.0	37.2	13.2	13.6	13.9	No	No
	Conrad	86.0	76.0	80.0	12.4	13.5	12.8	Yes	Maybe (screened)
	Havre	85.7	79.0	79.3	9.4	11.0	10.9	Yes	Maybe (screened)
	Sidney	71.0	74.0	67.0	11.6	12.2	11.8	Maybe (screened)	Maybe (screened)
	Moccasin	94.3	84.0	91.9	11.3	11.5	11.5	Yes	Yes
	Huntley	92.4	89.4	84.9	8.2	8.2	8.6	Yes	Yes
1996	Conrad	95.0	92.0	82.0	12.1	12.8	12.4	Yes	Maybe (screened)
	Havre	87.9	63.6	59.6	10.3	10.3	10.6	Yes	Maybe (screened)
	Sidney	87.8	79.3	66.9	13.2	13.7	12.9	Yes	Maybe (screened)
	Moccasin	12.1	18.2	9.5	13.4	14.4	15.0	No	No
	Huntley	69.9	30.4	37.4	13.4	14.3	13.9	Maybe (screened)	No
1995	Conrad	86.0	75.0	84.0	10.9	10.7	11.1	Yes	Maybe (screened)
	Havre	94.7	91.5	92.0	9.2	8.9	9.6	Yes	Yes
	Sidney	89.1	87.3	82.9	10.8	11.2	8.9	Yes	Yes
	Moccasin	92.1	69.6	79.2	9.2	8.6	9.2	Yes	Maybe (screened)
	Huntley	93.5	79.4	80.5	11.3	11.9	11.8	Yes	Maybe (screened)
	Conrad	91.0	87.0	94.0	8.8	9.2	9.4	Yes	Yes
1994	Havre	63.5	31.9	19.6				No	No
	Sidney	89.8	87.0	86.0	10.2	10.9	11.0	Yes	Yes
	Moccasin	24.8	13.0	40.0	11.9	11.4	11.5	No	No
	Huntley	21.2	6.2	21.0	14.3	15.7	14.0	No	No
	Conrad	80.0	84.0	93.0	10.9	12.1	11.4	Yes	Yes
	<b>Mean</b>	<b>74.4</b>	<b>65.2</b>	<b>63.6</b>	<b>13.0</b>	<b>13.6</b>	<b>13.5</b>		

\* The author assumed that about 85% plump and 12.5% protein were desirable maxima, but that with screening the window of acceptance could be widened. Under the author's assumptions, MT910189 could have been purchased for malt without screening from 20 of 47 attempts, while Harrington could have been purchased 9 of 47 attempts. The author recognizes that this rating is subjective and that disagreements in scoring are to be expected.



### Conclusions

MT910189 is an excellent alternative to Harrington and Harrington-like malting barley varieties, especially when grown in environments characterized by terminal drought. Earliness, coupled with good agronomics and superb malting quality, reduces risk to malting barley producers and will make the flow of grain from farmgate to malthouse and to brewery more predictable and efficient. With barley varieties like MT910189, Montana will become a more efficient and reliable source of 2-rowed malting barley for the domestic and international malting industries.

Respectfully submitted,

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