MALTING BARLEY QUALITY IN ALASKA: A PRELIMINARY STUDY

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INTRODUCTION

Barley is the cereal crop best adapted to Alaska's cool, short-season environment. Not surprisingly, barley is the most important agronomic feed crop in many north-latitude regions which experience similar growing season limitations. Results from long-term yield trials have demonstrated the consistently high yield potential of barley in Alaska. However, the lack of available markets and other economic considerations have limited the extent of its cultivation. An alternative use for barley in Alaska would help provide additional in-state markets. One such use is the production of Alaska-grown barley for use in locally brewed beers.

No research trials which investigate the malting quality of Alaska-grown barley are available. This study provides a preliminary assessment of the quality of malt barley produced in Alaska.

MATERIALS AND METHODS

Four malt barley varieties were used in this study: 'Bonanza', 'Argyle', 'Harrington', and 'Morex'. The first three varieties were developed in Canada, while Morex was developed in Minnesota. Harrington is a two-row barley, while the other three are six-row types.

The experiment was conducted at the University of Alaska Agricultural and Forestry Experiment Station farms at Palmer and Fairbanks. Prior to planting, 100 lbs/A each of P_2O_5, applied as 0-45-0, and K_20, applied as 0-0-50, were broadcast and incorporated. Because the quality of malt barley is strongly influenced by the level of available soil N, each variety was grown at 20, 40, and 80 lbs N per acre, applied as 34-0-0. All N fertility treatments were broadcast and incorporated prior to planting. Initial levels of soil fertility prior to the application of N fertilizer are presented in Table 1.

Plots were seeded May 1, 1990 at Palmer and May 15, 1990 at Fairbanks. Each plot consisted of eight 9.8 ft-long rows spaced 1 ft apart. The experimental design was a randomized complete block with four replications. The center four rows of each

Location	Residual N* (NO_3-N + NH_4-N)	Mehlich* P	Mehlich* K
	ppm	ppm	ppm
Palmer	43	40	61
Fairbanks	74	82	38

* 0-12 inch sampling depth

Table 1. *Levels of N, P, and K prior to application of N fertilizer.*

plot were harvested, and grain was dried at approximately 90° F for two days. Malt quality determinations were made at the Cereal Crops Research Unit, Madison, Wisconsin. Quality and agronomic characteristics measured included the following:

Barley protein .... Percentage protein content of barley kernels. Acceptable values are 12.0-13.5 for six-row and 11.5-13.0 for two-row varieties.

Kernel weight .... Average weight of one kernel in milligrams.

Plump kernels .... Percentage of kernels not falling through a 6/64" screen. Acceptable values are 70% minimum for six-row and 85% minimum for two-row varieties.

Barley color .... A measure of kernel brightness. Higher values indicate brighter kernels.

Malt extract .... A measure of soluble material obtained upon malt mashing. Should be equal to or greater than standard cultivar. Typical values range from 77- 81%.

Fine- minus coarse-grind extract difference .... An indication of the degree of malt modification. Values of less than two percentage points are considered acceptable.

Wort color and clarity .... An indication of wort clarity, as measured by optical absorbance. Acceptable values are usually between 1.4 and 2.1, with lower values representing clearer wort.

Soluble protein .... Protein from malt plus that produced in mashing. Minimum values are 5.2% for six-row and 5.0% for two-row varieties.

Soluble/total protein .... Ratio of soluble protein to total malt protein. Values of 40-45% are considered acceptable.

Diastatic power .... Ability to produce sugars from starch. Should be equal to or greater than standard cultivar. Acceptable values range from 110-150 degrees.

Alpha amylase .... The ability to dextrinize soluble starch. Should be equal to or greater than standard cultivar.

Malt quality ranking .... Index of relative malting quality of the treatments evaluated based on the quality characteristics described above. (1=best).

Days to maturity .... Number of days between planting and day when approximately 50% of heads have lost all green color.

Yield .... Grain yield in bushels/acre.

Test weight .... Weight of a given volume of harvested grain. Measured in lbs/bushel.

Results and Discussion

Growing conditions at Palmer were unusually warm and dry, while Fairbanks experienced generally normal temperatures and above-average precipitation. No lodging occurred at Palmer, while extensive lodging was present at Fairbanks.

Results from laboratory malting quality determinations along with agronomic performance for the four barley varieties studied are presented in Tables 2 and 3. In order to compare the malting quality of Alaska-grown barley with that of a standard variety grown in a malt barley production region, laboratory analyses were also performed using the standard malting variety Morex grown under favorable conditions in the continental US. These data are labeled as 'Morex standard' in Tables 2 and 3.

Elevated soil N concentrations at Fairbanks (Table 2), probably due to long-term applications of manure, contributed to excessively high grain protein, even at the 20 lbs N/A fertility rate. In fact, there was no grain protein or yield response to increasing N rates due to the high level of residual soil N. Since the upper limit of grain protein considered acceptable by most maltsters is 13.5%, samples from this test would not be suitable for malting. However both kernel weight and plump kernels are higher for all variety-treatment combinations. The probable cause and effect relationship between soil N levels and grain protein demonstrates the importance of soil N management in the production of high-quality malt barley.

Despite the relatively dry summer and below-average yields at Palmer, grain protein resulting from the low N fertility treatments was favorable (Table 3). The 20 lbs N/A rate resulted in lower barley protein than the Morex standard for three of four varieties. There was a general trend of increasing grain protein with higher N fertility. Except for

CULTIVAR	Applied N (lbs/A)	Barley protein (%)	Kernel weight (mg)	Plump Kernels (%)	Barley Color (Agtron)	Malt Extract (%)	Fine minus coarse extract (%)	Wort color & clarity	Soluble protein (%)	Soluble/ total protein (%)	Diastatic power (deg)	α Amylase (20 deg units)	Malting quality ranking	Days to maturity	Yield (bu/A)	Test weight (lbs/bu)
ARGYLE	20	18.5	35.0	93.1	51	76.3	2.7	1.4	6.26	34.1	152	40.9	1	83	92.5	51.3
ARGYLE	40	18.7	34.6	92.9	52	76.7	3.2	1.5	6.49	35.2	159	41.3	3	83	87.6	51.5
ARGYLE	80	18.4	34.9	93.1	50	76.5	3.0	1.5	6.19	33.6	136	40.9	2	83	87.9	51.2
BONANZA	20	19.7	35.2	88.2	51	75.5	4.0	1.4	6.32	32.5	128	38.6	7	82	78.5	51.6
BONANZA	40	19.9	34.6	89.5	53	75.5	3.9	1.4	6.40	32.2	128	37.9	9	82	76.7	52.1
BONANZA	80	19.8	35.0	88.9	52	75.1	3.6	1.5	6.41	32.7	129	38.5	8	82	74.7	51.6
HARRINGTON	20	17.5	43.1	94.4	43	77.0	4.9	1.2	5.52	32.0	103	37.3	5	81	91.7	54.9
HARRINGTON	40	17.4	41.7	92.9	46	76.7	4.9	1.3	5.45	31.2	99	36.3	6	81	88.8	55.1
HARRINGTON	80	16.8	41.9	90.6	42	77.5	5.3	1.2	5.57	33.0	102	36.4	4	81	95.0	55.0
MOREX	20	20.2	37.1	92.6	45	74.9	4.8	1.4	6.20	30.5	131	33.7	12	83	72.7	53.1
MOREX	40	20.5	37.9	93.6	46	74.5	4.8	1.4	6.04	29.8	129	34.7	10	83	69.4	53.9
MOREX	80	20.3	37.9	92.9d	46	75.4	4.8	.5	6.13	30.0	128	33.2	11	83	77.4	53.7
MOREX STANDARD		13.3	33.4	78.8	76	79.5	1.6	2.2	5.46	42.4	133	38.1				
LSD 0.05		0.8	1.1	3.2	3	1.1	0.9	0.2	0.34	1.5	20	2.6		1	8	0.9

***Table 2.** Performance of four malting barley cultivars grown at three rates of applied N at Fairbanks, Alaska in 1990.*

CULTIVAR	Applied N (lbs/A)	Barley protein (%)	Kernel weight (mg)	Plump Kernels (%)	Barley Color (Agtron)	Malt Extract (%)	Fine minus coarse extract (%)	Wort color & clarity	Soluble protein (%)	Soluble/ total protein (%)	Diastatic power (deg)	α Amylase (20 deg units)	Malting quality ranking	Days to maturity	Yield (bu/A)	Test weight (lbs/bu)
ARGYLE	20	12.6	33.7	86.7	54	78.4	1.6	1.4	4.00	32.3	123	36.1	4	93	57.2	50.3
ARGYLE	40	13.8	32.7	82.7	50	77.8	1.8	1.4	3.97	29.1	124	36.4	7	93	59.0	50.4
ARGYLE	80	14.2	31.4	77.9	53	76.2	1.6	1.4	3.85	27.7	132	34.3	10	93	58.6	49.2
BONANZA	20	13.3	36.0	86.3	48	77.8	1.9	1.4	3.83	29.1	105	33.4	9	92	57.2	50.4
BONANZA	40	14.1	34.4	84.1	47	77.0	2.5	1.4	4.10	29.5	104	32.1	11	93	54.6	50.5
BONANZA	80	14.9	35.1	82.6	47	75.7	1.9	1.3	4.24	28.3	121	33.5	12	93	65.8	50.2
HARRINGTON	20	12.7	41.4	89.2	56	79.5	2.5	1.2	4.05	33.0	94	36.8	1	88	60.5	53.7
HARRINGTON	40	12.9	41.4	88.2	57	79.0	2.4	1.2	4.23	32.7	95	35.9	2	88	58.0	53.3
HARRINGTON	80	14.3	40.5	86.3	55	77.9	2.5	1.2	4.25	30.7	117	36.7	6	88	58.3	52.9
MOREX	20	15.0	37.3	91.1	50	77.3	2.5	1.3	4.93	33.2	112	34.6	3	92	43.2	50.8
MOREX	40	16.0	36.4	89.5	47	76.6	2.3	1.3	5.01	32.1	139	35.8	5	92	44.0	51.3
MOREX	80	16.1	36.7	90.5	47	76.5	2.5	1.3	4.96	31.0	117	34.4	8	92	47.2	50.9
MOREX STANDARD		13.5	33.6	78.9	77	78.3	2.6	1.7	5.21	39.4	107	36.1				
LSD 0.05		0.9	1.2	3.1	4	0.7	0.6	0.1	0.26	2.4	30	2.2		2	6.1	0.8

***Table 3.** Performance of four malting barley cultivars grown at three rates of applied N at Palmer, Alaska in 1990.*

the 80 lbs N / A rate applied to Argyle, kernel weight of all treatments were higher than the Morex standard. Plump kernels decreased with increasing N fertility; however, all values were greater than the standard. Barley color was below the standard variety, indicating higher levels of kernel discoloration. This may be the result of the normally cool, moist weather during the grain maturation period in the Matanuska Valley. Malt extract was within acceptable limits, and fine- minus coarse-extract differences were better than the standard. Wort color and clarity values for all samples were better than the standard. The clarity of all variety-fertility combinations were classified as *clear*, in contrast to the Morex standard which was classified as *hazy* (data not shown). Soluble protein was lower than desirable, as was soluble / total protein. Diastatic power and alpha amylase were similar to the standard variety.

Since these conclusions represent data from only one environment, additional testing should be performed before these results are generalized. In particular, barley color, soluble protein, and soluble / total protein should be studied to determine if these characteristics fall below the standard using different varieties and growing conditions in Alaska.

The malting quality ranking for Palmer indicates two trends: Harrington was the top-performing variety, and the 20 lbs N / A fertility rate produced the highest quality grain for malting purposes. Compared to all other treatment combinations, the 20 lbs N / A rate for Harrington produced highest yield and test weight, and equaled the earliest maturity of 88 days.

Conclusions

Although growing conditions in Southcentral and Interior Alaska are not ideal for cereal grain production, this preliminary study indicates that, under proper management, it should be possible to produce a malting barley of acceptable quality in Alaska. At N fertility rates conducive to the production of malt barley, characteristics such as kernel weight, plump kernels, and wort color and clarity were better than the standard variety, while barley color, soluble protein, and total / soluble protein were poorer than the standard.

It should be noted that the production of high quality malting barley results from judicious selection of varieties and management practices which have been tailored to optimize quality characteristics for a specific region. Because no data on Alaska-grown malt barley were available, this study used a random set of varieties grown across a wide range of fertility rates. It is possible, therefore, that additional research would identify varieties and management practices which result in higher quality malt barley than the treatments we evaluated. It is also important to add that conclusions from this study result from limited data, and that additional evaluation performed over locations and years are required to substantiate our results.

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