

# 2012

## Malting and Brewing Trials of 2011 Cerveza Barley



CMBTC

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## Evaluation of the Malting and Brewing Performance of the new Canadian Two Row Variety Cerveza

### Summary

2011 crop barley samples of Cerveza, AC Metcalfe and CDC Copeland were provided to CMBTC by Dr. Bill Legge, Brandon Research Centre of Agriculture and Agri-Food Canada. These barleys were grown in trial plots located in Hamiota, Manitoba. Cerveza is a newly registered two-row spring malting variety developed by Dr. Bill Legge. This malting variety showed a fair to good resistance to lodging and very good malting quality.

The objective of this study was to examine the malting and brewing performance of this newly developed two-row variety. A general quality assessment, micro-malting and 10L brewing trials were carried out at CMBTC on this Cerveza barley sample versus control AC Metcalfe and CDC Copeland. The observed differences in barley quality, malting and brewing performance between Cerveza and the control AC Metcalfe and CDC Copeland are summarized in the box below:

Quality parameter	New 2-R Variety	Control	
	Cerveza	AC Metcalfe	CDC Copeland
<b>Barley</b>			
Protein content	Average	Average	Average
Germination energy	Good	Excellent	Good
Water sensitivity	Stronger	Strong	Strong
Plumpness	Very good	Very good	Very good
1000 Kernel weight	Good	Good	Good
<b>Malting</b>			
Process time	Average	Average	Average
Water uptake	Slower	Fast	Fast
Extract yield	Higher	High	High
Diastatic power	Average	High	Average
α-Amylase	High	High	Average
Soluble protein	Average	High	Average
Color	Slightly lower	Higher	Average

Brewing Performance			
Conversion Time	Slower	Fast	Average
Lautering Time	Average	Fast	Average
Wort Clarity	Good	Good	Average
Beer Quality			
Fermentability	Average	High	High
Colour	Lower	Higher	Average

Cerveza barley exhibited selectable quality for malting use. It showed good values in moisture content, protein content, thousand kernel weight and plumpness. It exhibited good germination energy but recorded strong water sensitivity. Its water sensitivity was stronger than either control AC Metcalfe and CDC Copeland. Its protein content was similar to CDC Copeland but lower than AC Metcalfe. In addition, Cerveza barley showed comparable thousand kernel weight and plumpness to the two controls.

Under the given trial malting conditions, this Cerveza barley did not exhibit any processing abnormalities. At steep, it showed good water uptake and obtained an acceptable chitting rate. During germination it showed normal acrospire growth. In the malting trial Cerveza barley produced malt with satisfactory quality. Its overall quality was comparable to the control AC Metcalfe and CDC Copeland, except for extract yield and beta-glucan content, which were significantly higher than the two controls.

In the brewhouse, the AC Metcalfe control recorded a considerably shorter conversion time (17 minutes) than CDC Copeland and Cerveza, which were more comparable (24 and 28 minutes respectively). AC Metcalfe and Cerveza both recorded a very fast time to clear of only 2 minutes, while CDC Copeland took somewhat longer to clear (5 minutes). AC Metcalfe recorded the shortest lautering time (42 minutes), followed by Cerveza (55 minutes) and finally CDC Copeland which took 60 minutes for the runoff. Wort pH was normal and comparable for all three wort samples. Wort clarity and break in the wort kettle were within specification. Beer colour generally followed the same trend as the congress wort colour. The lowest colour was recorded for the Cerveza sample (5.12), followed by CDC Copeland (5.22), while AC Metcalfe had the highest colour (5.53).

Please note that the micro-malting trials were conducted under the processing conditions similar to that usually used at CMBTC for processing commercial Canadian malting barleys. In order to realize the quality potential of Cerveza barley some further malting trials are needed to optimize the processing conditions. Since the results reported here are based on a limited number of trials, the test results should be viewed with caution.

## Introduction

In order to collect additional technical data for supporting the market development activities for the newly developed two-row Canadian barley variety Cerveza, CMBTC conducted micro-malting and 10L brewing trials on 2011 crop barley samples of Cerveza, AC Metcalfe and CDC Copeland using CMBTC's Joe White micro-malting system and 10L micro brewery. The barley samples of Cerveza, AC Metcalfe and CDC Copeland were harvested at the trial plots located at Hamiota, Manitoba. The barley samples were provided to CMBTC by Dr. Legge of Brandon Research Centre of Agriculture and Agri-Food Canada.

The objective of this study was to evaluate the malting and brewing performance of the newly developed Cerveza barley against the control AC Metcalfe and CDC Copeland. The malting and brewing trials for all three barley samples were conducted under the processing conditions similar to that used at CMBTC for evaluating newly harvested barley samples.

### 1. Barley Quality Analysis

When Cerveza, AC Metcalfe and CDC Copeland barley samples arrived at CMBTC, their quality was examined immediately, and the barley test results are given in Table 1. Please note that all the test results reported in Table 1 were generated from a single test except for the germination testing.

**Table 1. Analysis of 2011 crop barley samples of Cerveza and the control AC Metcalfe and CDC Copeland**

Barley ID	Moist, %	Protein, %	Germ., % (3 day, 4ml)	Germ., % (3 day, 8ml)	1000 Kernel wt., g	Over 6/64 sieve, %	Over 5/64 sieve, %	Thru, %	RVA
B-11-190 Cerveza	9.7	11.5	98.5	74.0	46.6	89.9	8.62	1.07	147
B-11-189 AC Metcalfe	9.3	12.6	99.5	82.0	46.9	95.7	4.01	0.36	130
B-11-188 CDC Copeland	9.5	11.4	97.0	80.5	46.6	96.3	2.99	0.46	138

The routine barley testing indicated that all the three barley samples had selectable quality for malting use, although there were some noticeable quality differences between the barley samples (Table 1). Cerveza, AC Metcalfe and CDC Copeland all showed good moisture content, desirable protein content, very good 1000 kernel weight and excellent plumpness. Their germination energy ranged from good to excellent but all recorded strong water sensitivity.

In comparison with the two controls, the Cerveza barley sample showed moisture content slightly higher than AC Metcalfe and CDC Copeland. Its protein content was similar to CDC Copeland but lower than AC Metcalfe. Its germination energy was slightly higher than CDC Copeland but lower than AC Metcalfe. Cerveza barley showed stronger water sensitivity than the two controls. Its thousand kernel weight and plumpness were comparable to the two controls. RVA values for Cerveza and the two controls were very good, indicating that these barleys had not experienced any pre-harvest sprouting damage. Therefore, good storability could be expected from these three barley samples. By comparison, Cerveza's RVA value was higher than the two controls.

## 2. Micro-malting Trial

Micro-malting trials were conducted on the barley samples of Cerveza and the control AC Metcalfe and CDC Copeland. The trials were conducted using CMBTC's Joe White micro-malting unit. The malting batch size for each of the three barley samples was 1000g (d. b.) with five repeats. The trial micro-malting conditions used in these trials are given in Box 1.

Please note that the processing conditions in the micro-malting trials were very generic, and were designed for examining newly harvested 2011 crop barley samples. In the trials, all the barley samples were steeped with a three-wet-period steep cycle and germinated for four days. During germination no water was applied to the green malts to adjust the moisture content. The steep-out moisture contents, chitting rates at the end of steep and acrospires growth profiles at the end of germination were recorded and the results are given in Table 2.

### Box 1. Details of the processing conditions for the micro-malting trials

#### STEEPING CYCLES

**43 hours (7 hrs Wet- 13 hrs Dry- 8 hrs Wet -13 hrs Dry -2hrs Wet)  
at 15°C**

#### GERMINATION CONDITIONS

**Day 1 @16°C Day 2& Day 3 & Day 4 @ 15°C**

#### KILNING CONDITIONS

**11 hrs@55°C; 5hrs@65°C; 1hrs @70°C; 2hrs @75°C and 4hrs @85°C**

**Water uptake, chitting and acrospire growth:**

Under the given malting trial conditions, at the end of steep, all three barley samples obtained satisfactory steep-out moisture and very good chitting rates (>85%) (Table 2). However, it was recorded that there were some varietal differences in water uptake and chitting rate. During germination, all the barley samples showed good acrospire growth, while significant varietal differences were recorded. Compared to the control AC Metcalfe and CDC Copeland, Cerveza barley showed slightly slower water-uptake, comparable chitting rate and slower growth of acrospires than the two controls.

**Table 2. Steep-out water content, chitting rate at the end of steep and profiles of acrospire growth at the end of germination**

Micro Malting ID	Varieties	Cast moisture (%)	Chitting (%)	Length of Acrospire at Steep out				
				0-1/4	1/4-1/2	1/2-3/4	3/4-1	>1
JW-11-167	Cerveza	48.8	98.3	0	0	0	83	17
JW-11-164	AC Metcalfe	49.1	96.7	0	0	3	78	19
JW-11-161	CDC Copeland	49.3	98.3	0	0	3	45	52

A complete malt analysis was carried out for the malts generated from the micro-malting trials, and the analytical results are detailed in Table 3.

**Table 3. Analysis of the malts generated from the micro-malting trials**

2011 crop	Cerveza	AC Metcalfe	CDC Copeland
Moisture, %	4.2	4.1	4.0
Friability, %	80.3	81.2	88.8
Fine-extract, %	82.2	81.5	80.6
F/C Difference, %	1.6	1.6	1.2
Soluble protein, %	4.85	5.42	5.12
Total protein, %	11.6	11.7	11.4
Kolbach Index, %	42.0	46.2	44.8
Beta-Glucan, ppm	169	81	68
Viscosity, cps	1.45	1.42	1.44
Diastatic power, °L	128	146	126
α-Amylase, D.U.	86.0	97.6	74.6
Colour, ASBC	2.32	2.58	2.54
Wort pH	5.94	5.86	5.85
Fan, mg/L	187	223	207

**Overall modification:** In the micro-malting trials no noticeable processing difficulties were experienced for any of the three barley samples included in the micro-malting trials. However, it was noted that there were some significant varietal differences in overall modification among the barley samples. The values for F/C difference, soluble protein, FAN and enzymes suggested that this Cerveza barley sample produced malt with satisfactory quality (Table 3), although its beta-glucan content was slightly higher than levels desired by brewers (<150ppm). In contrast, the control AC Metcalfe and CDC Copeland samples produced malts with better modification as indicated by higher friability and significantly lower beta-glucan content.

**Extract yield and enzyme levels:** Cerveza malt exhibited very good extract yield, which was significantly higher than the control AC Metcalfe and CDC Copeland (Table 3). Cerveza malt developed good levels of enzymes. Its diastatic power levels were lower than AC Metcalfe but similar to CDC Copeland, while its alpha-amylase was lower than AC Metcalfe but higher than CDC Copeland.

**Soluble protein, FAN and malt color:** Cerveza malt showed good soluble protein content, good FAN and good malt color. Its soluble protein content and FAN levels were lower than the control AC Metcalfe and CDC Copeland. Its malt color was slightly lower than the control AC Metcalfe than CDC Copeland.

**Beta-glucan content and wort viscosity:** Cerveza malt showed less advanced beta-glucan breakdown during processing as indicated by the elevated beta-glucan content, which was higher than that required by brewers (<150ppm). Its beta-glucan content was significantly higher than the two controls. However, its wort viscosity was within the acceptable range and was comparable to the two controls.

**Overall performance:** Under the given trial malting conditions, this Cerveza barley did not exhibit any processing abnormalities. At steep, it showed good water uptake and obtained good chitting rate. During germination it showed normal acrospire growth. In the malting trial Cerveza barley produced malt with satisfactory quality. Its overall quality was comparable to the control AC Metcalfe and CDC Copeland, except for extract yield and beta-glucan content, which were significantly higher than the two controls.

### 3. Micro Brewing Trial

Malts produced from the malting trials were micro brewed in CMBTCs 10L Micro Brewery. The following are the brewing and fermentation conditions for the brewing trials with Cerveza, AC Metcalfe and CDC Copeland malt samples.

#### Mash Tun

- 100% malt brew – 1.5 kg of malt and 5L of water added to mash tun
- Mash in at 48°C, hold for 30 min
- Raise to 65°C, hold for 30 min
- Raise to 77°C
- Pump over to Lauter Tun

#### Lauter Tun

- Rest for 5 minutes, vorlauf for 10 minutes
- Rakes on slow for entire lautering
- 250 mL underlet
- 6L sparge water at 75°C

#### Brew Kettle

- First hop (Nugget) boiled for 60 min – 2g

#### Fermentation

- 2 x 1.5L of wort was cooled to 15°C
- Both subsamples pitched with lager yeast at 1.25 million cells per mL
- Fermented for 5 days

The brewing results are given in Tables 4, and 5.

**Table 4: Main Brewhouse observations for micro brewing trials with Cerveza, AC Metcalfe and CDC Copeland malts**

Parameter	Cerveza SB-12-006	AC Metcalfe SB-12-005	CDC Copeland SB-12-004
Conversion time (min.)	28	17	24
Time to clear (min.)	2	2	5
Lautering time (min.)	55	42	60
Wort pH	5.26	5.20	5.21
Wort Colour (SRM)	4.89	6.20	5.89



In the brewhouse, the AC Metcalfe control recorded a considerably shorter conversion time (17 minutes) than CDC Copeland and Cerveza, which were more comparable (24 and 28 minutes respectively). This could partially be explained by the levels of amyolytic enzymes which were somewhat higher in AC Metcalfe than in the other malt samples. Conversion time is a metric that is important for the brewer in regards to the economics of his brewhouse. Longer conversion times could translate into higher operating costs in more energy requirement, higher labour costs or decreased capacity. Conversion time is related to the enzyme content of the malt, and can be manipulated by changing malt: water ratio and temperature.

Time for wort to clear to less than 100 FTU in lautering for all malt samples was good. AC Metcalfe and Cerveza both recorded a very fast time to clear of only 2 minutes, while CDC Copeland took somewhat longer to clear (5 minutes). Time required for the wort to clear is a metric that is important for the brewer in regards to the economics of his brewhouse as well as the quality of the finished beer. Most brewers want clear wort, which provides better quality beer and also allows for better capacity utilization in fermentation. The time therefore to obtain wort that is clear (less than 100 FTU) is therefore related to capacity and manpower utilization.

There was some difference in runoff times between the different malt samples. AC Metcalfe recorded the shortest lautering time (42 minutes), followed by Cerveza (55 minutes) and finally CDC Copeland which took 60 minutes for the runoff. Runoff time of these samples did not correlate well with their malt  $\beta$ -Glucan content. Time to complete the runoff is a metric that is important for the brewer in regards to the economics of his brewhouse. Longer times could translate into higher operating costs in more energy requirement, higher labour costs or decreased capacity. Runoff time is related to the beta-glucan content of the malt as well as the friability and milling of the malt.

Wort pH was normal and comparable for all three wort samples. There was a good correlation between the levels of malt soluble protein and wort colour. AC Metcalfe recorded the highest wort colour, followed by CDC Copeland and finally Cerveza, which also had the lowest malt soluble protein levels.

Wort clarity and break in the wort kettle were within specification. Wort clarity and good protein precipitation is related to improved colloidal stability of the final product.

Beer colour (Table 5) generally followed the same trend as the congress wort colour. The lowest colour was recorded for the Cerveza sample (5.12), followed by CDC Copeland (5.22), while AC Metcalfe had the highest colour (5.53). Most international brewers are looking for a lower pale colour to be derived from the malt, so the lower the better.

The Real Degree of Fermentation (RDF) samples from Cerveza, AC Metcalfe and CDC Copeland are also presented in Table 5. On average AC Metcalfe had the highest RDF. The RDF of CDC Copeland was slightly lower, while Cerveza showed the lowest RDF

values. The higher the RDF the better: this allows the brewer to produce more beer per kg of malt.

CDC Copeland had higher Original Gravity than AC Metcalfe and Cerveza which were more comparable. This was probably the result of more vigorous boiling and higher evaporation rate when CDC Copeland was brewed. All the samples recorded relatively comparable and expected apparent and real extract values. The final alcohol levels with all three samples were high (5.98 to 6.80) which were also expected because of the relatively high Original Gravities.

**Table 5: Fermentation observations and basic beer analysis**

Parameter	Cerveza SB-12-006	AC Metcalfe SB-12-005	CDC Copeland SB-12-004
Original Gravity (Plato)	14.2	14.5	16.3
Apparent Ext. (Plato)	3.79	3.09	3.69
Real Ext. (Plato)	5.91	5.29	6.08
RDF (%)	61.95	65.32	64.32
Alcohol (v/v %)	5.98	6.17	6.80
Color (ASBC)	5.12	5.53	5.22

For more information, please contact CMBTC.

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