

Report of the Malting and Brewing Trials with the 2011 Quality Scoop Barley Samples

Summary

2011 crop Quality Scoop (QS) samples (blend of barley from all selection areas in Western Canada) of AC Metcalfe and CDC Copeland were provided to CMBTC by the CWB. CMBTC conducted routine barley analysis, pilot malting and pilot brewing tests with these QS barley samples. The objective of this study was to examine the malting and brewing performances of the newly harvested AC Metcalfe and CDC Copeland barley samples to aid in developing processing guidelines for the 2011 crop malting barley for customers of Canadian malting barley.

2011 crop QS samples of AC Metcalfe and CDC Copeland showed improved overall quality than last year crop. The barley samples showed acceptable grain moisture content, desirable protein content, very good thousand kernel weight, good plumpness and good germination energy with slight water sensitivity. In addition, RVA values for these samples were very high, which indicated that these samples had not suffered from pre-harvest sprouting damage. Therefore, good storability can be expected from 2011 crop AC Metcalfe and CDC Copeland.

In the pilot malting trials, under the given processing conditions, all of the 2011 crop QS samples of AC Metcalfe and CDC Copeland performed well, and did not show any difficulties in processing. They exhibited good water uptake and good chitting at steep, and showed good acrospire growth during germination. The malts produced from these QS barley samples all showed satisfactory values in friability, extract level, soluble protein, enzymes, FAN levels and color, as well as low beta-glucan content in all of the finished malts. Compared with the 2010 crop QS barley samples, all 2011 crop QS barley samples showed satisfactory overall malting performance and produced malts with quality better than or comparable to the malts of 2010 crop QS barleys, although the overall malting performance and quality of the resultant malt varied from variety to variety and from trial to trial.

Malting trial results suggested that 2010 crop AC Metcalfe and CDC Copeland can be processed under normal processing conditions for Canadian two-row malting barleys. However, processing conditions that are known to effect malt soluble protein and malt color should be closely monitored throughout the malting process.

In pilot brewing trials, AC Metcalfe and CDC Copeland malts showed different conversion times, which were on average typically longer than in previous years. It seems that the samples that were harvested earlier in the season exhibited longer conversion times. Time for worts to clear to less than 100 FTU was very good for both AC Metcalfe and CDC Copeland. Average lautering times for both AC Metcalfe and CDC Copeland samples were comparable to the averages of the last two crop years. Malt Material Yields for both samples were good. Wort colour for both AC Metcalfe and CDC Copeland were generally low, where AC Metcalfe recorded slightly lower values. The pH values were typical for of the trial wort samples.

Average brewhouse yields for both 2011 QS samples were good. The fermentabilities of the wort produced from the 2011 samples also were very good.

All malts produced beer with acceptable quality. All the beers produced from 2011 crop QS showed generally low colours. Beers produced from AC Metcalfe offered somewhat higher foam values. The initial and chill turbidity for all 2011 QS samples were exceptionally good, indicating good physical and colloidal stability.

1. Barley Quality Analysis

CMBTC received five QS barley samples of AC Metcalfe and CDC Copeland collected from 2011 harvest provided by CWB, which were to represent the overall quality of 2011 crop readily available to the customers of Canadian malting barley. CMBTC was not involved in the collecting and blending of these QS barley samples.

When the QS barley samples arrived at CMBTC, quality of the barley samples was examined prior to the malting trials, and the test results are summarized 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.

QS AC Metcalfe samples from 2011 harvest showed bright appearance and no signs of mould infection and/or staining. AC Metcalfe samples recorded acceptable moisture contents and desirable protein contents (Table 1). Compared with 2010 QS samples, 2011 QS AC Metcalfe's moisture content and protein content were lower. 2011 QS barley samples showed very good germination energy with slight water sensitivity, and their germination energy was higher than 2010 QS samples, and their water sensitivity was less than 2010 QS samples. In addition, 2011 QS AC Metcalfe samples showed excellent thousand kernel weight and plumpness. Their thousand kernel weight was significantly higher than 2010 QS samples, but their plumpness was comparable to 2010 QS samples.

As observed with QS samples of 2011 AC Metcalfe, the QS samples of CDC Copeland from 2011 harvest also showed a bright appearance and no signs of mould infection and/or staining. They recorded acceptable moisture contents and desirable protein contents (Table 1). For all three CDC Copeland samples, their moisture contents were lower than the 2010 QS samples, and their protein contents were comparable to 2010 QS samples. All 2011 QS CDC Copeland barley samples exhibited very good germination energy and slight water sensitivity, and their germination energy and water sensitivity were better than 2010 QS samples. In addition, 2011 QS CDC Copeland barley samples showed excellent thousand kernel weight and plumpness. On average, their thousand kernel weight was significantly higher than 2010 QS samples, but their plumpness was lower.

Table 1. Quality evaluation of the QS barley samples from 2011 harvest

Variety/ID#	Moisture, %	Protein, %	Germination, % (4ml, n=2)	Germination, % (8ml, n=2)	1000 Kernel wt, g	Sizing, %			RVA
						>6/64 sieve	>5/64 sieve	Through	
2011 QS samples									
B-11-038 AC Metcalfe	12.1	12.0	100	97.5	45.8	93.3	5.21	0.82	160
B-11-095 AC Metcalfe	11.9	11.9	97.5	92.0	48.2	91.9	4.12	2.39	128
Mean	12.0	12.0	98.8	94.8	47.0	92.6	4.67	1.61	144
B-11-094 CDC Copeland	13.3	11.4	99.5	90.5	51.7	93.3	4.56	1.52	170
B-11-107 CDC Copeland	12.4	11.7	98.5	93.0	47.7	92.1	5.72	1.54	152
B-11-176 CDC Copeland	12.5	11.1	100	93	47.4	91.6	4.84	1.24	N/A
Mean	12.7	11.4	99.3	92.2	48.9	92.3	5.04	1.43	161
Average of 2010 QS									
AC Metcalfe	13.5	12.4	96.3	86.3	44.9	92.9	5.20	0.91	65.4
CDC Copeland	13.3	11.3	96.3	82.5	44.8	94.1	4.00	1.31	23.4

All of the QS barley samples of AC Metcalfe and CDC Copeland from 2011 harvest reported high RVA values (≥ 135). This indicated that these barleys had not suffered any pre-harvest sprouting damage; therefore, good storability can be expected from 2011 crop AC Metcalfe and CDC Copeland barleys.

In general, 2011 QS barley samples showed improved overall quality. In comparison with 2010 QS barley samples, 2011 QS barley samples had comparable protein content, better thousand kernel weight, improved germination energy and lighter water sensitivity.

2. Pilot-malting Trials

One pilot malt trial with a batch size of 55 kg cleaned barley was conducted on each of these QS samples of AC Metcalfe and CDC Copeland. All of the malting trials were carried out in CMBTC's pilot malting system using the processing conditions given in Table 2.

Please note that steeping conditions varied slightly from trial to trial, but germination and kilning conditions were kept identical in all the pilot malting trials.

Table 2. Malting conditions for processing 2011 crop QS barley samples of AC Metcalfe and CDC Copeland

	AC Metcalfe		CDC Copeland	
	Sample #1 (B-11-038) PM-11-046	Sample #2 (B-11-095) PM-11-054	Sample #1 (B-11-094) PM-11-051	Sample #3 (B-11-176) PM-11-062
Steeping				
Steep temp. (°C)	14	14	14	14
1st Wet Time (hrs)	7	8	9	6
1st Dry Time (hrs)	12	11	12	13
2nd Wet Time (hrs)	9	9	8	9
2nd Dry Time (hrs)	14	14	12	14
3rd Wet Time (hrs)	1	1	3	2
Total Steeping Time (hrs)	43	43	44	44
Germination				
1st day Germ Temp (°C)	15	15	15	15
2nd day Germ Temp (°C)	15	15	15	15
3rd day Germ Temp (°C)	14	14	14	14
4 th day Germ Temp (°C)	14	14	14	14
Total Germ Time (hrs)	96	96	96	96
Kilning				
Kilning Time (hrs)	21	21	21	21
Temp(°C) at the end kilning	82	82	82	82

2011 QS AC Metcalfe

In the malting trials, 2011 QS AC Metcalfe barley samples did not show any difficulties in processing. At the end of steep, the barley samples obtained satisfactory steep-out moisture contents and very good chitting rates (Table 3). During germination, the barley samples showed good growth of acrospires and good progress of modification. In comparison with 2010 QS barley samples, at steep-out, 2011 QS AC Metcalfe samples showed faster water up-take, and obtained comparable chitting. During germination 2011 QS AC Metcalfe samples showed a growth profile of acrospires comparable to 2010 QS AC Metcalfe.

Table 3. Steep-out moisture content, chitting rate and growth profile of acrospires for 2011 QS AC Metcalfe

2011 AC Metcalfe		Steep-out Moisture (%)		Chitting rate (%)	
(B-11-038) PM-11-046		45.6		95.0	
Acrospire growth					
	0-1/4 (%)	1/4-1/2 (%)	1/2-3/4 (%)	3/4-1 (%)	>1 (%)
24 hours	5	35	60	0	0
48 hours	0	50	40	10	0
72 hours	0	0	40	60	0
96 hours	0	0	0	90	10
2011 AC Metcalfe		Steep-out Moisture (%)		Chitting rate (%)	
(B-11-095) PM-11-055		45.6		100	
Acrospire growth					
	0-1/4 (%)	1/4-1/2 (%)	1/2-3/4 (%)	3/4-1 (%)	>1 (%)
24 hours	0	55	45	0	0
48 hours	-	-	-	-	-
72 hours	0	0	10	80	10
96 hours	0	0	10	65	25
2010 QS AC Metcalfe (Mean n=2)					
2010 AC Metcalfe		Steep-out moisture (%)		Chitting rate (%)	
		44.0		97.5	
Acrospire growth					
	0-1/4 (%)	1/4-1/2 (%)	1/2-3/4 (%)	3/4-1 (%)	>1 (%)
24 hours	5	45	40	10	0
48 hours	0	7.5	40	52.5	0
72 hours	0	0	35	65	0
96 hours	0	0	22.5	57.5	20

Complete malt analysis was carried out for the pilot malting trials, and the analytical results are given in Table 4. For comparison, the table also includes the average malt analysis of AC Metcalfe for the malting trials carried out at CMBTC with 2010 and 2009 crop QS AC Metcalfe barley samples.

Table 4. Malt analysis and quality evaluation for 2011 crop QS barley samples of AC Metcalfe

Parameter	2011 QS AC Metcalfe			2010 QS AC Metcalfe	2009 QS AC Metcalfe
	PM-11-46 B-11-038	PM-11-54 B-11-059	Mean	Mean	Mean
Malt moist, %	4.2	3.9	4.1	4.0	3.8
Friability, %	83.9	84.0	84.0	76.4	85.5
Fine-extract, %	80.8	81.2	81.0	80.2	80.4
Coarse-extract, %	80.1	80.6	80.4	79.6	79.8
F/C Difference, %	0.7	0.6	0.7	0.65	0.6
Soluble protein, %	4.98	5.72	5.35	5.12	5.09
Total protein, %	11.5	11.5	11.5	11.6	11.29
Kolbach Index, %	43.2	49.6	46.4	44.5	45.1
Beta-Glucan, ppm	74	73	73.5	179	95.5
Diastatic power, °L	143	145	144	174	169
α-Amylase, D.U.	58.3	62.6	60.5	67.2	67.3
Wort colour, ASBC	2.07	2.37	2.22	2.09	1.94
Wort pH	6.00	5.97	5.99	5.93	6.02
Fan, mg/L	182	203	193	210	236

Malting Summary

- **General modification:** The values for friability, F/C difference, soluble protein content and beta-glucan content all suggested that the two 2011 QS samples of AC Metcalfe produced malts with very good modification.
- **Extract yield and enzyme levels:** In comparison with the trial averages of 2010 and 2009 QS samples of AC Metcalfe, the malts produced from 2011 QS AC Metcalfe samples exhibited significant higher extract yield. The malts developed adequate levels of enzymes, although their α -Amylase and diastatic power were lower than the QS samples of 2010 and 2009 crops.
- **Soluble protein, free amino nitrogen (FAN) and malt colour:** The malts produced from the barley samples of 2011 QS AC Metcalfe exhibited good protein solubilisation, which was slightly higher than 2010 and 2009 crop QS samples as indicated by higher soluble protein content and Kolbach Index. The malts also developed adequate levels of FAN, but the levels were lower than 2010 and 2009 QS samples. Malt colour for 2011 QS AC Metcalfe barley samples was good but was higher than 2010 and 2009 QS samples.

Comments on the malting process

During the malting process, no difficulties were recorded for the 2011 crop QS AC Metcalfe barley samples. The barley samples were processed under normal processing conditions for quality evaluation of Canadian two-row malting barley.

At steeping target a steep-out moisture content of 43-44% and over 85% chitting rate. The steeping cycle should consist of 2 or 3 wet periods at 14-16 °C. In germination avoid high temperature and excessive watering to control acrospire growth and protein breakdown. In kilning a lower curing temperature (80-82 °C) should be considered to avoid excessive malt color formation.

CDC Copeland

In the malting trials, 2011 crop QS samples of CDC Copeland did not show any processing difficulties. At the end of steep, the CDC Copeland samples obtained satisfactory steep-out moisture contents and excellent chitting rates (Table 5). During germination, the samples showed good growth of acrospires. In comparison with 2010 crop QS CDC Copeland samples, 2011 crop QS CDC Copeland samples showed faster water up-take and comparable chitting rates at the end of steep. During germination, 2011 crop QS CDC Copeland barley samples showed slower acrospire growth than the 2010 QS CDC Copeland.

Table 5. Steep-out moisture content, chitting rate and growth profile of acrospires for 2011 QS CDC Copeland barley

CDC Copeland #1		Steep-out moisture (%)			Chitting rate (%)	
(B-11-094) PM-11-051		44.0			100	
Acrospire growth						
	0-1/4 (%)	1/4-1/2 (%)	1/2-3/4 (%)	3/4-1 (%)	>1 (%)	
24 hours	0	30	60	10	0	
48 hours	0	5	85	10	0	
72 hours						
96 hours	0	0	10	75	15	
CDC Copeland #3		Steep-out moisture (%)			Chitting rate (%)	
(B-11-176) PM-11-062		45.3			100	
Acrospire growth						
	0-1/4 (%)	1/4-1/2 (%)	1/2-3/4 (%)	3/4-1 (%)	>1 (%)	
24 hours	0	30	60	10	0	
48 hours	0	0	50	50	0	
72 hours	0	0	30	60	10	
96 hours	0	0	10	85	5	
2010 QS Copeland (Mean n=2)						
2010 CDC Copeland		Steep-out moisture (%)			Chitting rate (%)	
		43.8			100	
Acrospire growth						
	0-1/4 (%)	1/4-1/2 (%)	1/2-3/4 (%)	3/4-1 (%)	>1 (%)	
24 hours	2.5	40	50	7.5	0	
48 hours	0	7.5	42.5	47.5	2.5	
72 hours	0	0	15	80	5	
96 hours	0	0	2.5	60	37.5	

Complete malt analysis was carried out for the two pilot malting trials, and the analytical results are given in Table 6. For comparison, the table also includes the average malt analysis of CDC Copeland malting trials carried out at CMBTC with 2010 and 2009 crop QS CDC Copeland barley samples.

Table 6. Malt analysis and quality evaluation for 2011 crop QS CDC Copeland barley

Parameter	2011 QS CDC Copeland			2010 QS CDC Copeland	2009 QS CDC Copeland
Pilot-malting #	PM-11-051 (B-11-094)	PM-11-062 (B-11-176)	Mean	Mean	Mean
Malt moisture, %	4.2	4.0	4.1	3.8	3.9
Friability, %	86.6	92.8	89.7	86.7	87.3
Fine-extract, %	81.1	80.8	81.0	80.4	80.8
Coarse-extract, %	80.0	80.5	80.3	79.4	80.3
F/C Difference, %	1.1	0.3	0.7	1.0	0.5
Soluble protein, %	5.28	5.25	5.27	5.20	5.27
Total protein, %	11.3	10.8	11.1	11.4	11.3
Kolbach Index, %	46.9	48.6	47.8	45.8	46.5
Beta-Glucan, ppm	88	70	79	133	103
Diastatic power, °L	130	114	122	131	146
α-Amylase, D.U.	48.2	43.9	46.1	48.1	54.9
Wort colour, ASBC	2.17	2.29	2.23	2.34	1.85
Wort pH	6.00	5.92	5.96	5.91	5.92
Fan, mg/L	188	189	189	226	257

Malting Summary

- **General modification:** The values for friability, F/C difference, soluble protein content and beta-glucan content all suggested that these two 2011 QS CDC Copeland samples produced malts with very good modification.
- **Extract yield and enzyme levels:** The malts produced from 2011 QS CDC Copeland samples exhibited extract yield slightly higher than 2010 crop QS samples and similar to 2009 QS samples. The malts from 2011 QS Copeland developed good levels of enzymes, although both α -amylase and diastatic power were lower than 2010 and 2009 QS Copeland samples.
- **Soluble protein, free amino nitrogen (FAN) and malt colour:** The malts produced from the 2011 crop QS Copeland samples exhibited slightly higher protein modification than those QS samples of 2010 and 2009 crops. The malts also developed adequate levels of FAN, but the levels were lower than in the 2010 and 2009 QS samples. Malt colour for 2011 QS Copeland barley was good, and it was slightly lower than 2010 QS samples but significantly higher than 2009 QS samples.

Comments on the malting process

During the malting process, no difficulties were recorded for the 2011 QS CDC Copeland barley samples. 2011 CDC Copeland barley can be processed under normal processing conditions for Canadian two-row malting barley. However, please pay attention to processing conditions that affect soluble protein and malt colour.

At steep, target a steep-out moisture content of 43-44% and over 85% chitting rate. The steeping cycle should consist of 2 or 3 wet periods at 14-15 °C. In germination avoid high temperature and excessive watering to control the growth of acrospires and protein breakdown. In kilning the curing temperature can be similar to that used for processing AC Metcalfe (80-82°C). 2011 QS CDC Copeland did not show the tendency of producing lower malt color.

3. Pilot-brewing Trials

Malts produced from the malting trials were pilot brewed in CMBTCs 300L Pilot Brewery. Malts from the two 2011 QS Metcalfe and two 2011 QS Copeland trials were brewed separately. The following is the mashing and fermentation conditions for the brewing trials with the 2011 QS sample malts:

Mash Tun

- 100% malt brew – 40 kg of malt and 150L 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 76°C
- Pump over to Lauter Tun

Lauter Tun

- Rest for 10 minutes, vorlauf for 10 minutes
- Rakes at 20 cm above bottom, on slow for entire lautering
- 25L underlet
- 125L sparge water at 75°C

Brew Kettle

- First hop (Nugget) boiled for 90 min – 37g
- Second hop (Mt. Hood) boiled for 5 min – 75g

Fermentation, aging, filtering and bottling conditions for the brewing trials

- Cooled to 13.5°C, pitched with lager yeast at 1.25 million cells per mL
- Fermented for 7 days (3 days at 13.5°C and 4 days at 15°C)
- Cooled and stored at -0.5 °C for 7 days
- Filtered through a 1 µm pad filter system, carbonated to 2.5 volumes CO₂
- Stored 2 days at -2°C, and packaged
- Pasteurized to 15 PU

The brewing results are given in Tables 7 to 14.

Table 7. Malt grist composition (%) for the 2011 QS brewing trials

Sieve	AC Metcalfe*	CDC Copeland*
#10	4.89	7.47
#14	12.25	15.38
#20	31.7	29.25
#30	16.55	14.77
#60	18.62	16.53
#100	6.97	6.24
On pan	9.99	11.34

*Average of 2 brewing trials

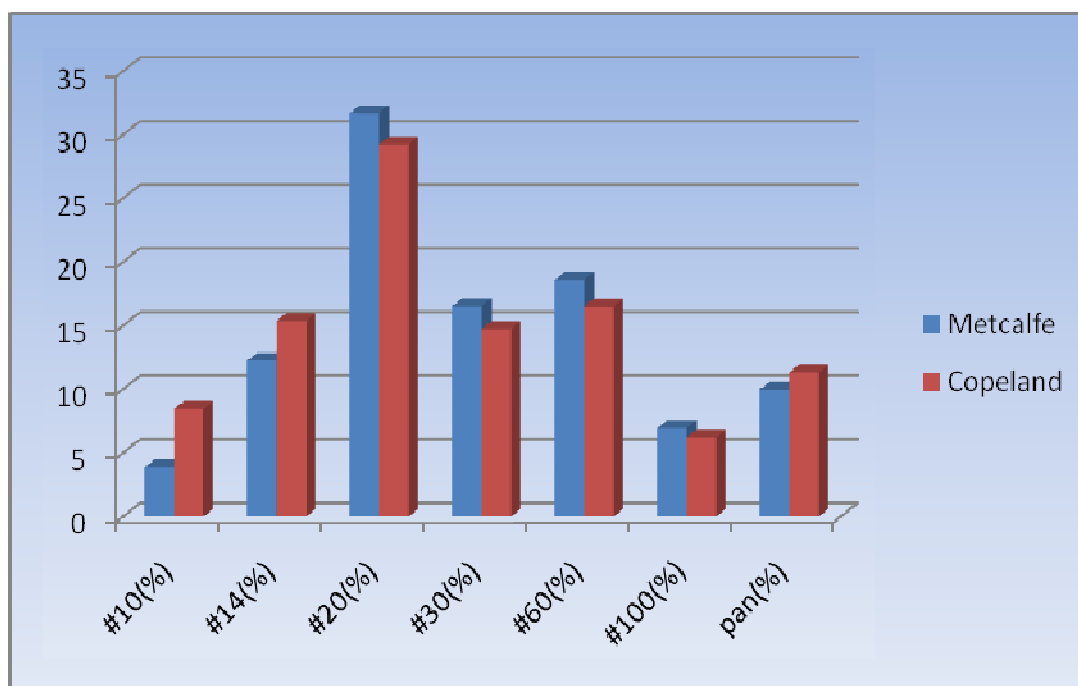


Figure 1: Malt Grist Ratios for the 2011 samples

There were no problems recorded for milling the 2011 quality scoop derived malt, although some variations in malt grist compositions among the barley varieties were observed (Table 7, Figure 1). Milled malt from CDC Copeland recorded slightly increased amounts of fine flour particles, however, the differences were not large enough to affect brewing performance.

Table 8. Brewhouse observations for the brewing trials for 2011.

Parameter	AC Metcalfe*	CDC Copeland*
Conversion time (min.)	17	19
Time to clear (min.)	5	6.5
Lautering time (min.)	59	59
Malt Material Yield (%)	87.3	89.4
Wort pH	5.45	5.61
Wort Colour (SRM)	3.27	3.53

*Average of 2 brewing trials

In the brewhouse, the malts for the two QS barley varieties showed different conversion times, which were on average typically longer than in the previous five crop years except for the averages from 2007 crop year (Table 9). There was a big difference in conversion times between the two AC Metcalfe samples. The first AC Metcalfe sample took 24 minutes for starch conversion, while the second one converted in only 10 minutes. The two CDC Copeland samples took 22 and 16 minutes to convert respectively. It seems that the samples that were harvested earlier in the season had longer conversion times. Time for worts to clear to less than 100 FTU was very good for both AC Metcalfe and CDC Copeland. Average lautering times for both AC Metcalfe and CDC Copeland samples were 59 minutes, and were comparable to the averages of the last two crop years (Table 10). Malt Material Yields for both samples were good, ranging from 87.3% for AC Metcalfe to 89.4% for CDC Copeland. Wort colour for both AC Metcalfe and CDC Copeland were generally low, where AC Metcalfe recorded slightly lower values. The pH values were typical for of the trial wort samples.

Table 9. Conversion times for 100% malt brews with 2011 crop, versus 2010, 2009, 2008, 2007 and 2006 quality scoop.

	QS 2011	QS 2010	QS 2009	QS 2008	QS 2007	QS 2006
AC Metcalfe	17	11	8.5	10.5	25	16
CDC Copeland	19	11.5	10	11	18	16

Table 10. Lautering times for 100% malt brews with 2010 crop, versus 2009, 2008, 2007 and 2006 quality scoop.

	QS 2011	QS 2010	QS 2009	QS 2008	QS 2007	QS 2006
AC Metcalfe	59	59	58.5	62	54	57
CDC Copeland	59	59	58	61.5	57	62

Average brewhouse yields for both 2011 QS samples were good. AC Metcalfe showed somewhat lower values than in the previous few years, while CDC Copeland showed slightly higher values than in the previous two crop years (Table 11).

Table 11 Brewhouse yields for 2010 crop, versus 2009, 2008, 2007 and 2006 quality scoop.

	QS 2011	QS 2010	QS 2009	QS 2008	QS 2007	QS 2006
AC Metcalfe	70.1	71.7	71.1	73.3	74.1	73.3
CDC Copeland	71.8	70.9	70.8	74.2	72.2	72.5

Normal sugar spectra were recorded for both 2011 QS varieties (Table 12). The 2011 QS average wort carbohydrate spectrum for AC Metcalfe and CDC Copeland were in general comparable. CDC Copeland recorded slightly higher levels of Maltotriose and Maltose fermentable sugars.

Table 12. Wort sugar concentration for the brewing trials (mg/L)

Carbohydrate	AC Metcalfe	CDC Copeland
Maltotetrose	3.00	3.17
Maltotriose	13.30	14.72
Maltose	57.23	61.31
Glucose	12.89	12.95
Fructose	2.23	2.36

The fermentabilities of the wort produced from the 2011 samples (Table 13) were very good. AC Metcalfe and CDC Copeland had comparable attenuation limits.

Table 13: Fermentation observations for the brewing trials

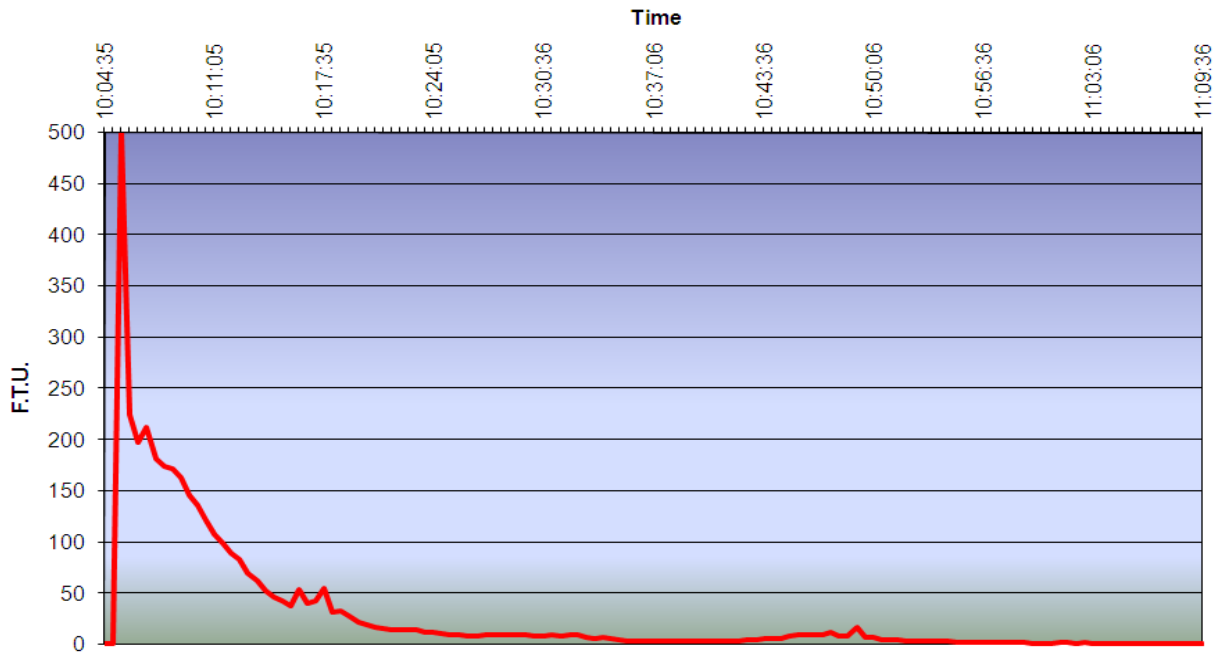
Brews	AC Metcalfe	CDC Copeland
Attenuation Limit (%)	86.14	86.0

Runoff turbidities for the test malts were within the normal range for the 2011 QS produced malts (Figures 2 – 5). Clarity below 100 FTU was typically obtained in less than 7 minutes for all the samples. Wort clarity curve recorded for both varieties tested was normal and comparable, with CDC Copeland showing slightly longer time for initial turbidity reduction.

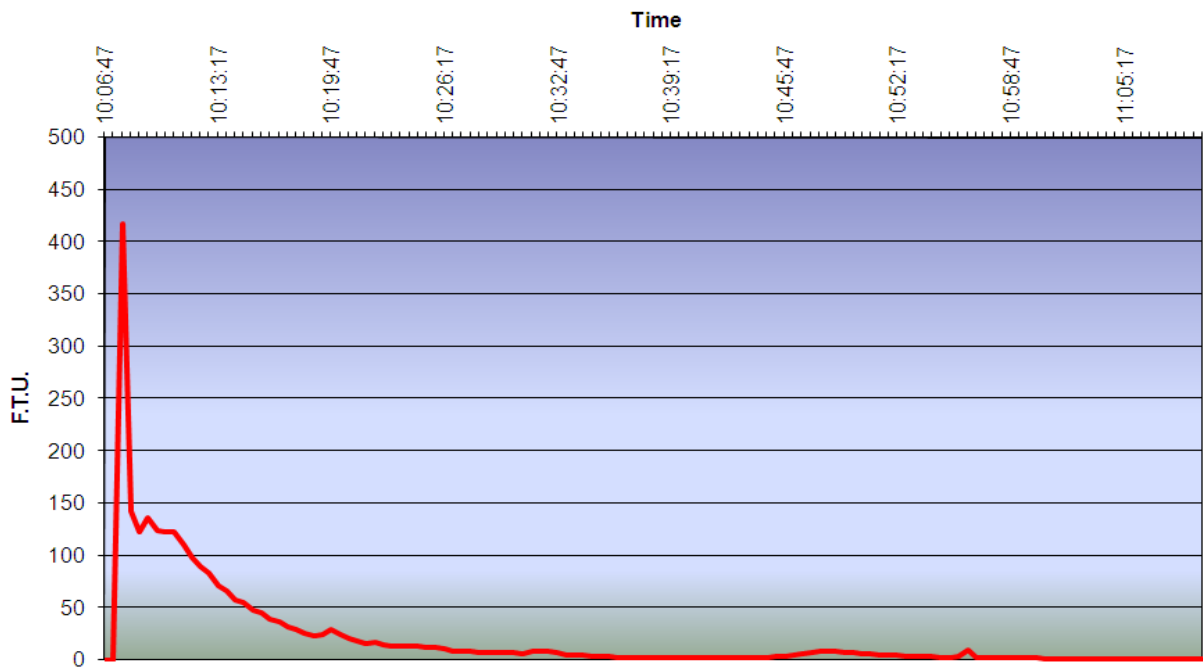
Runoff specific gravity profiles for the test malts were within the normal range for the 2011 QS samples (Figures 6 – 9).



PB-11-046: Runoff Lautertun Turbidity



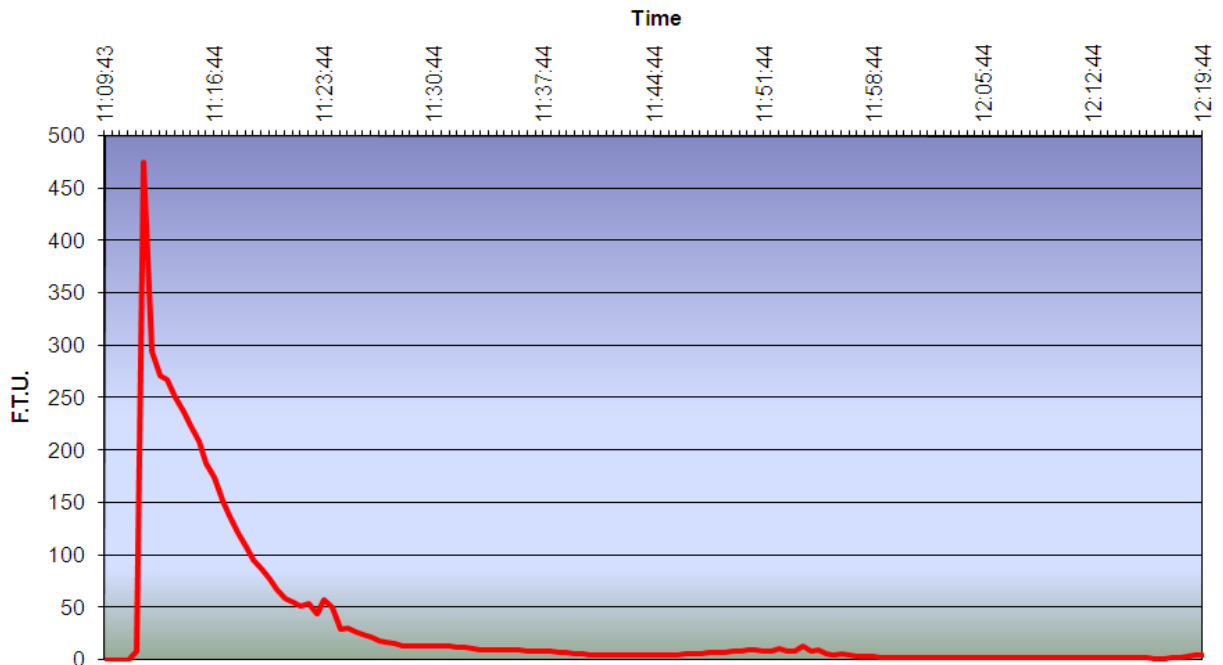
PB-11-049: Runoff Lautertun Turbidity



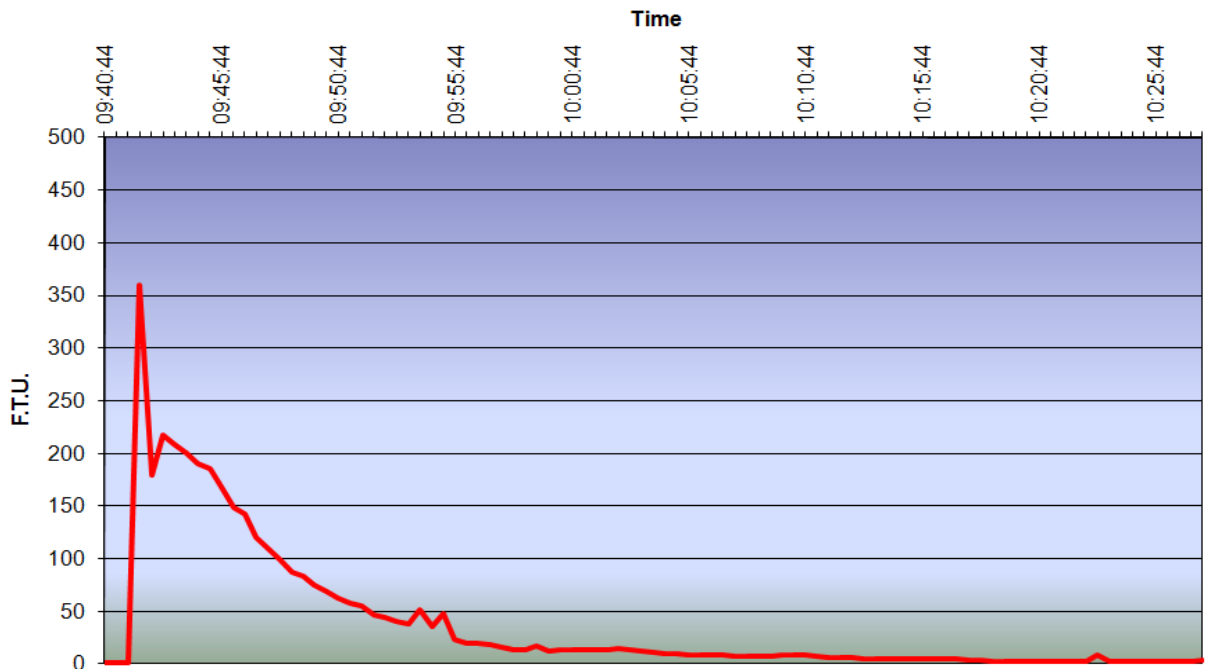
Figures 2 and 3: AC Metcalfe runoff turbidity profiles for the 2011 QS test malts.



PB-11-051: Runoff Lautertun Turbidity



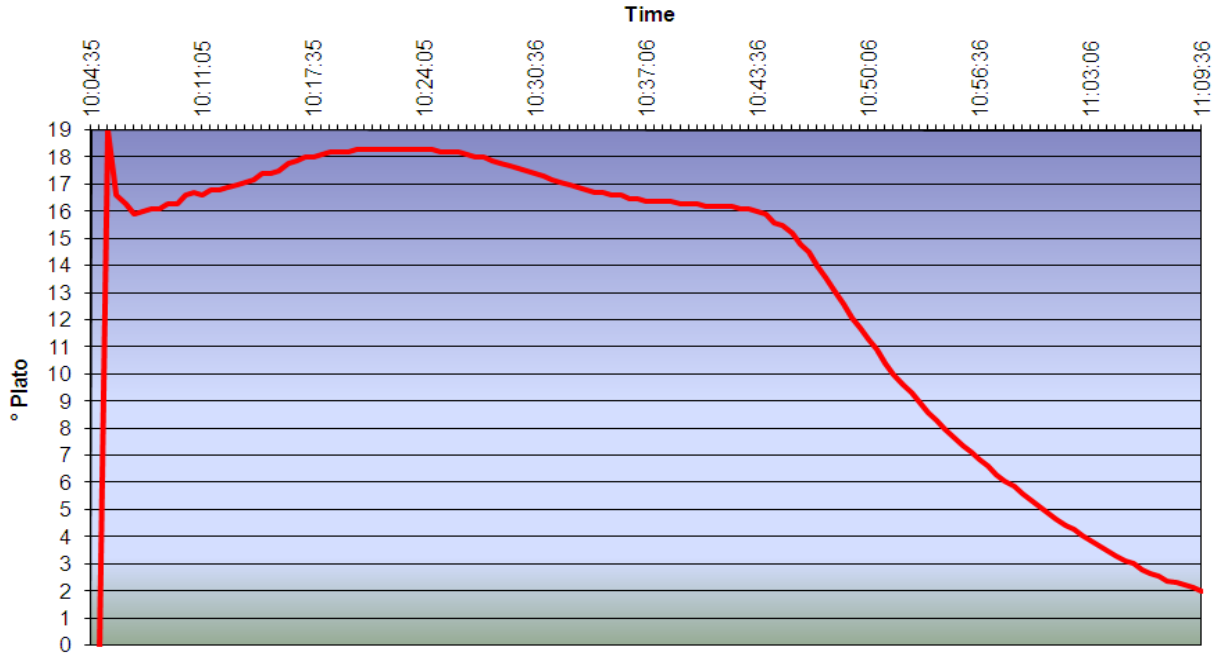
PB-11-060: Runoff Lautertun Turbidity



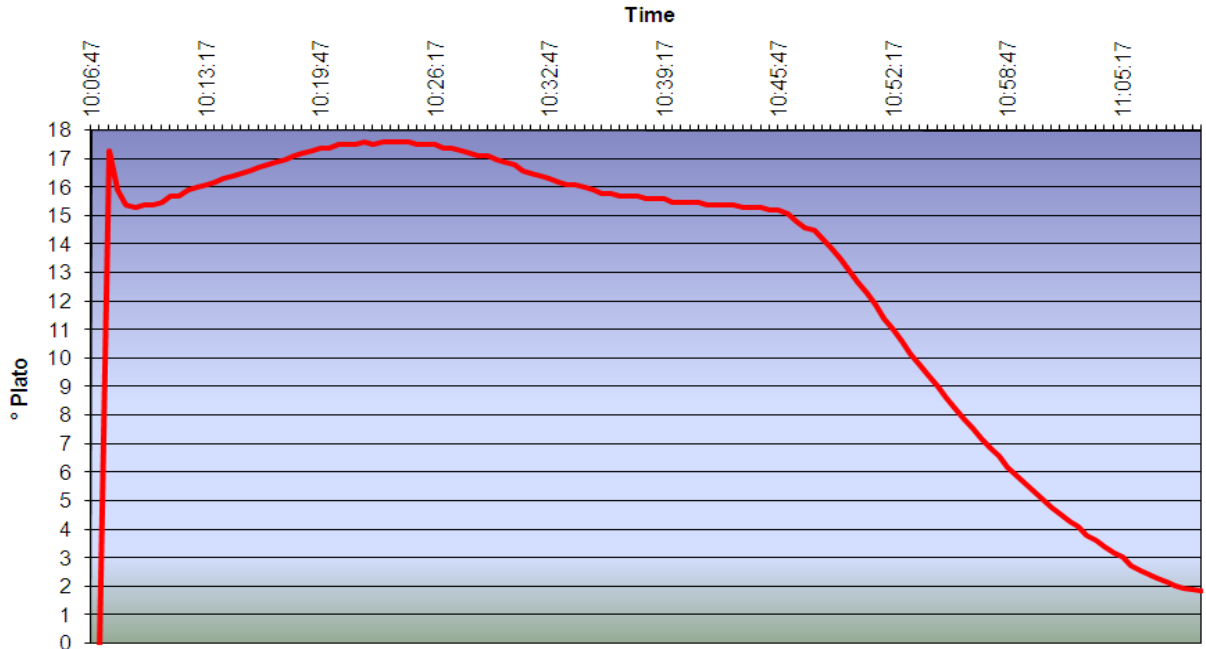
Figures 4 and 5: CDC Copeland runoff turbidity profiles for the 2011 QS test malts.



PB-11-046: Runoff Lautertun Specific Gravity



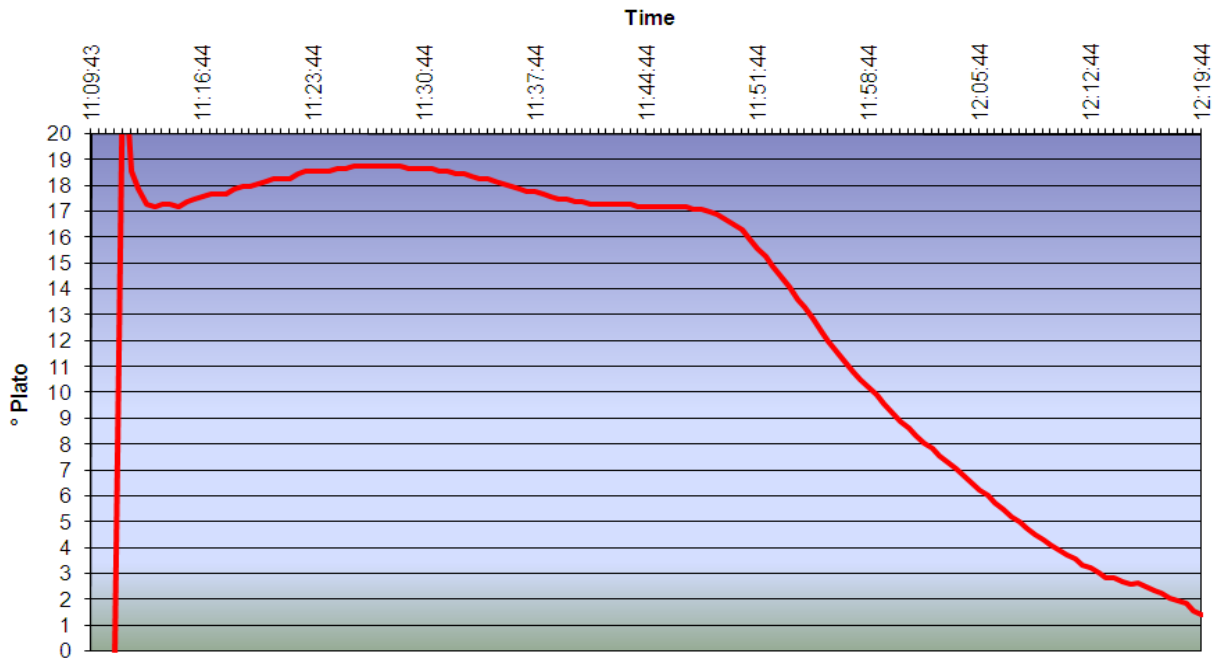
PB-11-049: Runoff Lautertun Specific Gravity



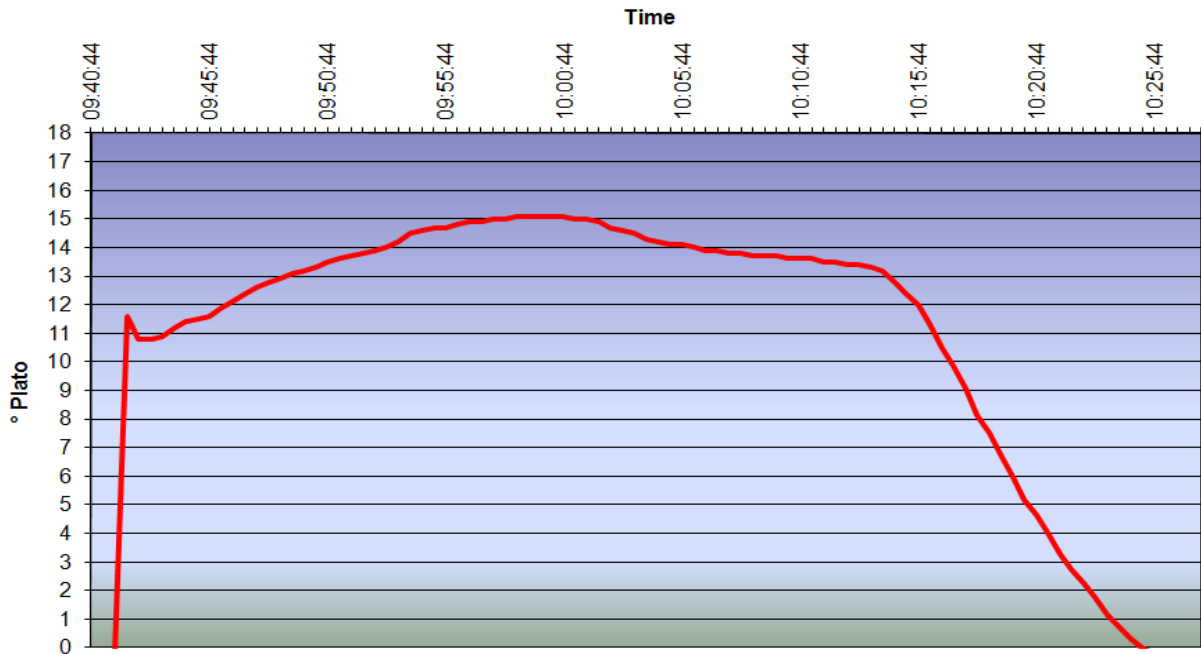
Figures 6 and 7: AC Metcalfe runoff runoff specific gravity profiles for the 2011 QS test malts.



PB-11-051: Runoff Lautertun Specific Gravity



PB-11-060: Runoff Lautertun Specific Gravity



Figures 8 and 9: CDC Copeland runoff specific gravity profile for the 2011 QS test malts.

All malts produced beer with acceptable quality (Table 14). All the beers produced from 2011 crop QS showed generally low colours. CDC Copeland showed slightly lower beer colour than AC Metcalfe samples. Beers produced from AC Metcalfe offered somewhat higher foam value. The initial and chill turbidity for all 2011 QS samples were exceptionally good, indicating good physical and colloidal stability.

Table 14. Final beer analysis

Parameter	AC Metcalfe	CDC Copeland
Apparent Extract (Plato)	1.69	1.53
Real Extract (Plato)	3.57	3.46
Alcohol, %	5.17	5.32
Color, (ASBC)	2.73	2.60
pH	4.40	4.32
Foam (sec)	208	193
Initial Turbidity (FTU)	12.68	13.28
Chill Turbidity (FTU) 24 Hr	13.67	15.42
Forcing Turbidity (FTU)	100	182
IBU	10.33	10.78

The produced beers were analyzed by the CMBTC Expert Taste Panel. All trial beers were rated as reasonably fresh, normal good beer with no obvious defects.

AC Metcalfe samples were clean and clear, slightly harsh with very good foam and low body. Slight estery and sulphury notes were also present.

CDC Copeland beer samples were also clean and clear, somewhat dry with good carbonation. Beer had some estery flavours with slight grainy and very slight diacetyl notes.

For more information, please contact CMBTC:

Rob McCaig, Managing Director and Director of Brewing

Tel: (204) 983-1981

Email: rmccaig@cmbtc.com

Yueshu Li, Director of Malting Technology

Tel: (204) 984-0561

Email: yli@cmbtc.com

Fax 204-984-5843