



Report of the Malting and Brewing trials with the 2009 Quality Scoop Barley Samples

Summary

Quality scoop (QS) barley samples (blend of barley from all selection areas for 2009 harvest) of AC Metcalfe, CDC Copeland, CDC Kendall and Newdale, barleys were provided by the CWB to CMBTC. CMBTC conducted routine barley analysis, pilot malting and brewing trials with these QS barley samples. The objective of these trials was to examine the malting and brewing performance of a composite of these newly harvested barley samples. Additionally, the data generated would be used for developing the processing guidelines for the 2009 crop barley for the customers of Canadian malting barley.

Barley test results indicated that all of the QS barley samples from the 2009 harvest had desirable low protein content, very good 1000 kernel weight and plumpness, and showed no obvious staining or weathering. In addition, all the barley varieties recorded good germination energy and exhibited only limited water sensitivity.

In the pilot malting trials, under the given processing conditions no major problems were encountered; all of the 2009 QS barley samples produced quality malts with overall quality better or comparable to last year crop, although the overall malting performance and resultant malt quality varied from variety and from trial to trial.

The 2009 QS AC Metcalfe sample produced malts with better overall malt quality than the 2008 QS sample as indicated by better values for friability, extract yield, soluble protein and FAN as well as lower beta-glucan and higher enzymes.

The 2009 QS CDC Copeland sample produced malts with quality comparable to the 2008 QS samples with enhanced soluble protein and FAN, as well as higher diastatic power.

The 2009 QS CDC Kendall sample produced malts with better values in friability, extract yield, soluble protein, FAN, enzymes and beta-glucan content than the 2008 QS sample.



The 2009 QS Newdale sample produced malt with friability and extract yield comparable to the 2008 QS sample, but it exhibited improved soluble protein and FAN. In addition its malt showed lower diastatic power and higher beta-glucan content than the 2008 QS sample.

Malting trial results suggested that for 2009 crop, AC Metcalfe, CDC Copeland and CDC Kendall barleys can be malted easily; they do not require special processing conditions. However, for malting Newdale barley, maltsters may need to adjust processing conditions to lower its malt beta-glucan content.

In the brewing trials, no major problems were encountered. There were no major differences in grist ratio after milling. Even though malt from CDC Copeland recorded increased amounts of fine flour particles, the differences were not large enough to affect brewing performance. The malts for all five barley varieties showed conversion times shorter than in the previous two crop years and comparable to averages from the 2003 to 2005 crop years. Times for wort in lautering to clear to less than 100 FTU were very good and typically shorter than 10 minutes. Lautering times for all the samples were comparable and close to 60 minutes. Malt material yields for all of the samples were very good, ranging from 90% for CDC Kendall to 93.4% for CDC Copeland. Brewhouse yields for the 2009 QS samples were excellent for CDC Copeland and AC Metcalfe, and very good for other three varieties.

The wort carbohydrate spectra were normal and comparable for all of the 2009 QS samples'. The fermentabilities of the worts produced from the 2009 QS samples were very good and superior to the previous two crop years. As recorded in past trials, CDC Kendall worts exhibited the highest fermentabilities of the varieties. Wort and beer color were generally low for 2009 QS samples and final beer colloidal and physical stability were excellent.



1. Barley quality analysis

Six QS samples of four barley varieties were provided to CMBTC by CWB, which were to represent the overall quality of 2009 crop AC Metcalfe, CDC Copeland, CDC Kendall and Newdale barley readily available to the customers of Canadian malting barleys. Please note that CMBTC was not involved in the collecting and blending these barley samples.

When these QS barley samples arrived at CMBTC, the quality of the barley samples were examined quickly and the test results are summarized in Table 1. Please note that except for the germination testing all the testing results reported in Table 1 were generated from a single test.

Table 1.1 Quality evaluation of the 2009 quality scoop barley samples

Variety/ Barley ID	Moisture, %	Protein, %	Germination, %		1000 Kernel wt, g	Sizing, %			RVA
			(4ml, n=2)	(8ml, n=2)		>6/64 sieve	>5/64 sieve	Throug h	
2009 QS									
AC Metcalfe	13.2	11.4	100	85	46.1	92.8	5.60	1.01	56.0
	12.3	11.4	100	93	47.0	93.6	5.17	0.65	-
CDC Copeland	12.4	11.0	100	93	47.9	94.3	4.29	0.87	30.0
	12.9	11.5	100	95	49.4	95.4	3.88	0.54	-
CDC Kendall	12.8	11.2	100	94	44.9	95.4	3.55	0.58	70.0
Newdale	12.9	11.4	98	85	46.2	92.4	6.32	1.17	102.2
Average of 2008 QS									
AC Metcalfe	13.1	12.25	97.5	94	45.5	94.7	3.86	1.03	102
CDC Copeland	12.9	11.3	99.5	93.5	47.5	96.4	2.84	0.75	120
CDC Kendall	13.6	12.5	98.5	92	46.3	97.3	2.02	0.49	105.3
Newdale	13.3	12.1	99	88	43.7	94.8	4.18	0.93	120.5

General comments on barley quality

The 2009 QS samples of AC Metcalfe, CDC Copeland, CDC Kendall and Newdale all recorded acceptable levels of moisture content and very desirable protein content (Table 1.1). These barley samples also recorded very good



CMBTC
CANADIAN MALTING BARLEY TECHNICAL CENTRE

TECHNICAL REPORT

germination energy and exhibited some water sensitivity. All barley samples showed excellent thousand kernel weight and plumpness. All of these barley samples showed no obvious signs of mould infection, staining or weathering.

AC Metcalfe, CDC Copeland, CDC Kendall and Newdale barley samples all had RVA values lower than 135, which suggested that these could have been affected by the pre-germination. The RVA values were lower than that recorded for the 2008 harvest indicating that there could be some challenges in storability of 2009 crop Canadian malting barley. These barleys should not be stored under high humidity and high temperatures for prolonged periods.

In general, the 2009 QS barley samples showed good overall quality. In comparison with 2008 QS barley samples, 2009 QS barley had lower protein content and showed better values in germination energy, 1000 kernel weight and plumpness. However, their RVA values were significantly lower than 2008 QS barleys.



2. Pilot-malting trials

For 2009 QS barley samples of AC Metcalfe and CDC Copeland two pilot-malting trials were conducted, but for 2009 QS CDC Kendall and Newdale only one malting trial was conducted due to the limited quantity of these barley samples.

The processing conditions used in each of these pilot malting trials are detailed in Table 2.1. Please note that steeping and germination conditions varied slightly from trial to trial, but kilning conditions were identical in all the malting trials.

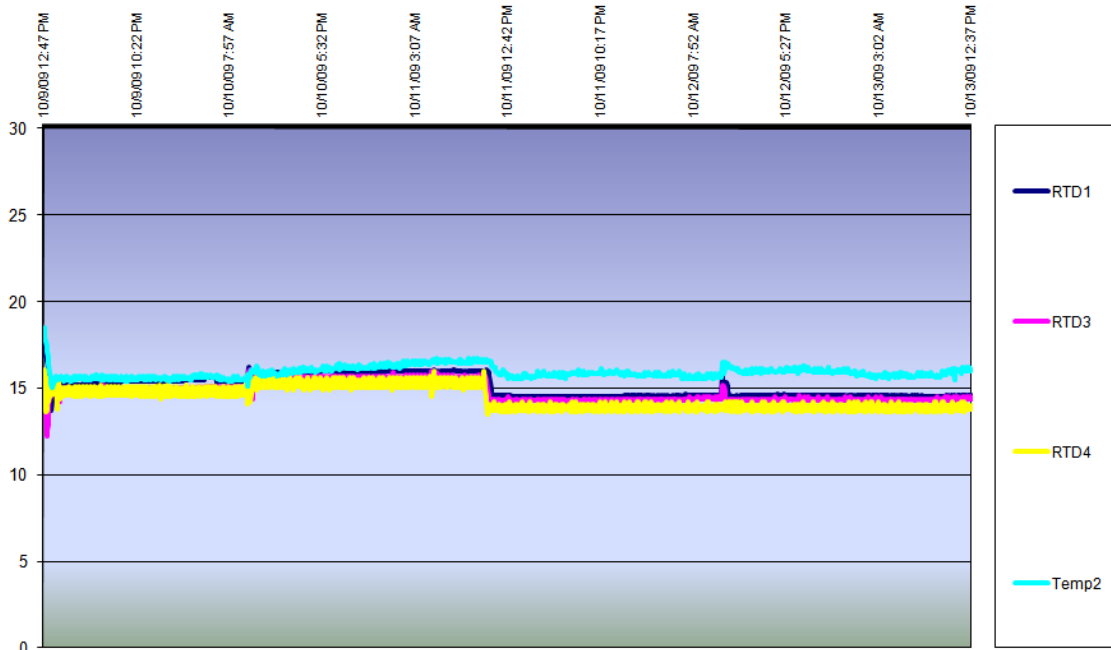
Table 2.1 Processing conditions for the pilot malting trials

Variety	AC Metcalfe #1	AC Metcalfe #2	CDC Copeland #1	CDC Copeland #2	CDC Kendall #1	Newdale
Protein, %	11.4	11.4	11.0	11.5	11.2	11.4
Steeping Time (hrs)						
1st Wet Period	7	7	7	8	7	8
1st Dry Period	12	12	14	15	13	12
2nd Wet Period	9	9	9	8	9	8
2nd Dry Period	14	14	10	10	12	11
3rd Wet Period	3	3	4	3	4	4
Total steeping Time	45	45	44	44	45	43
Temp (°C)	15	15	15	15	15	15
Germination Conditions						
1st Day Temp (°C)	15	15	16	15	15.5	15
2nd Day Temp (°C)	15	15	15	16	15.5	15
3rd Day Temp (°C)	14	14	15	15	14	15
4th Day Temp (°C)	14	14	14	15	14	15
Total Germ Time (hrs)	96	96	96	96	96	96
Kilning Conditions						
Total Kilning Time (hrs)	21	21	21	21	21	21
Temp(°C) at end of Kilning	82	82	82	82	82	82

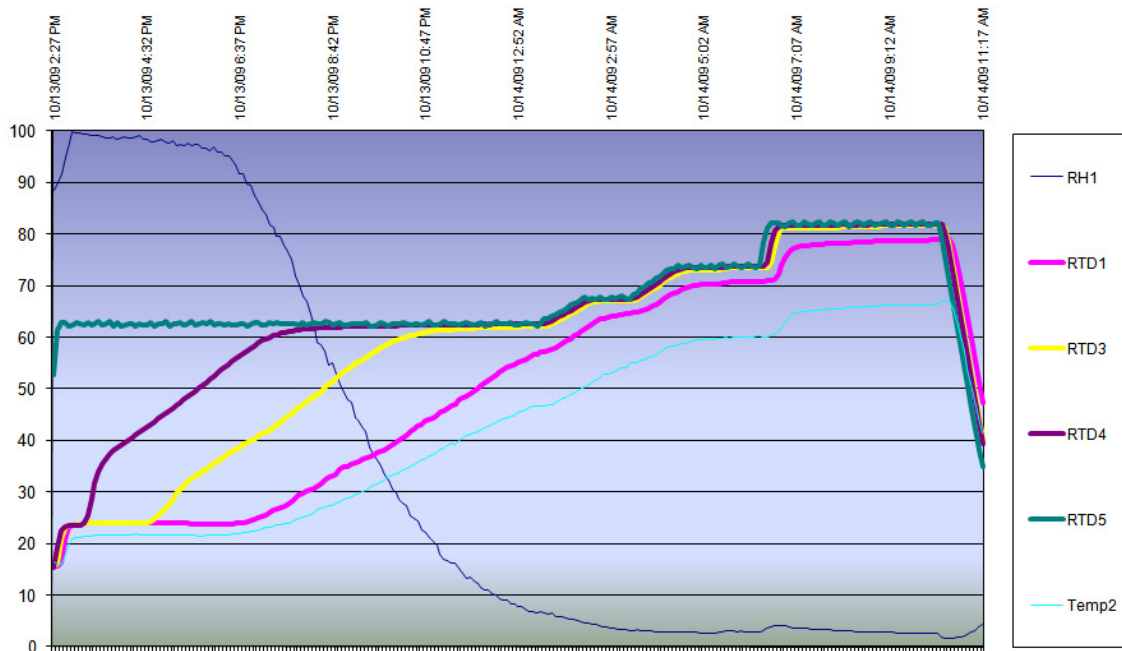


Two example charts showing the temperature profiles for the germination and kilning are also given below for reference.

PM-09-038 Germination



PM-09-038 Kilning





3. Malting Performance

AC Metcalfe

At steep the two 2009 QS AC Metcalfe barley samples (#1 & #2) both obtained satisfactory steep-out moisture contents and excellent chitting rates (Table 3.1). During germination, they showed good growth of acrospires and good progress of modification.

Table 3.1 Steep-out moisture content and chitting rate and acrospire growth of 2009 QS AC Metcalfe barley

AC Metcalfe #1		Steep-out Moisture (%)			Chitting rate (%)	
		44.6			100	
Acrospire growth						
	0-1/4 (%)	1/4-1/2 (%)	1/2-3/4 (%)	3/4-1 (%)	>1 (%)	
24 hours	20	50	30	0	0	
48 hours	0	20	50	30	0	
72 hours	0	0	15	80	5	
96 hours	0	0	5	80	15	
AC Metcalfe #2		Steep-out moisture (%)			Chitting rate (%)	
		44.8			100	
Acrospire growth						
	0-1/4 (%)	1/4-1/2 (%)	1/2-3/4 (%)	3/4-1 (%)	>1 (%)	
24 hours	20	45	35	0	0	
48 hours	0	5	50	45	0	
72 hours	0	0	20	75	5	
96 hours	0	0	15	85	0	

The malts produced from these two pilot-malting trials showed good extract level and soluble protein content, excellent enzyme levels, good FAN levels, low beta-glucan content and normal range of malt color (Table 3.2). However, on average malt friability was higher than the 2008 QS barley samples, and was comparable to 2007 QS barley samples.



Table 3.2. Malt analysis and quality evaluation for 2009 QS AC Metcalfe barley samples

Parameter	2009 QS AC Metcalfe		2008 QS AC Metcalfe	2007 QS AC Metcalfe
	#1	#2	Mean	Mean
Pilot-malting Sample				
Malt moisture, %	3.6	3.9	4.2	4.0
Friability, %	83.6	87.3	76.05	86.0
Fine-extract, %	80.6	80.2	80.2	80.1
Coarse-extract, %	79.6	79.9	79.9	79.5
F/C Difference, %	1.0	0.2	0.4	0.6
Soluble protein, %	5.24	4.93	5.17	5.20
Total protein, %	11.54	11.04	12.06	12.28
Kolbach Index, %	45.4	44.7	42.9	42.5
Beta-Glucan, ppm	82	109	101	145
Diastatic power, °L	178	159	154	139
α-Amylase, D.U.	70.6	63.9	59.9	64.4
Wort colour, ASBC	1.92	1.96	1.84	2.08
Wort pH	6.03	6.01	5.87	5.90
Fan, mg/L	264	207	220	208

Malting Summary

- **General modification:** The values for friability, F/C difference, beta-glucan content, and soluble protein content all suggested that these two AC Metcalfe barley samples produced well modified malts.
- **Extract yield and enzyme levels:** In comparison with the averages of 2008 and 2007 QS samples, the malts produced from these 2009 QS samples exhibited comparable extract yield. On average, their α-Amylase and diastatic power were higher than 2008 and 2007 QS samples.
- **Soluble protein, free amino nitrogen (FAN) and malt colour:** The malts produced from these two AC Metcalfe barley sample exhibited higher protein modification than that of 2008 and 2007 QS samples as indicated by higher Kolbach Index. The malts also developed FAN levels higher than 2008 and 2007 QS samples. Their malt colour was slightly higher than 2008 QS sample but lower than 2007 QS sample.



Comments on the malting process

During the malting process, no difficulties were recorded for these two AC Metcalfe barley samples.

Please pay attention to processing conditions that influence friability.

2009 AC Metcalfe can be processed under normal malting conditions used for Canadian two-row malting barley since it has lower protein content and showed no significant water sensitivity.

At steeping target steep-out moisture of 43-44% and over a 85% chitting rate. The steeping cycle should consist of 2 or 3 wet periods at 15-16 °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

At steep these two 2009 QS CDC Copeland barley samples (#1 & #2) both obtained satisfactory steep-out moisture content and excellent chitting rates (Table 3.3). During germination, they both showed normal acrospire growth and progress of modification.

Table 3.3 Steep-out moisture content, chitting rate and growth of 2009 QS CDC Copeland barley

CDC Copeland #1		Steep-out moisture (%)			Chitting rate (%)	
		44.45			100	
Acrospire growth						
	0-1/4 (%)	1/4-1/2 (%)	1/2-3/4 (%)	3/4-1 (%)	>1 (%)	
24 hours	5	60	25	10	0	
48 hours	0	30	30	40	0	
72 hours	0	0	10	90	0	
96 hours	0	0	0	95	5	
CDC Copeland #2		Steep-out moisture (%)			Chitting rate (%)	
		44.5			100	
Acrospire growth						
	0-1/4 (%)	1/4-1/2 (%)	1/2-3/4 (%)	3/4-1 (%)	>1 (%)	
24 hours	15	55	30	0	0	
48 hours						
72 hours	0	10	40	40	10	
96 hours	0	0	15	50	35	



In the malting trials, 2009 QS CDC Copeland barley produced malts with a very good quality profile. The produced malts showed good friability, low beta-glucan content, and good soluble protein, excellent levels of enzyme and FAN, as well as good malt color (Table 3.4). Compared with the 2008 and 2007 QS samples, the fine extract level was comparable; the friability value was lower for 2009 CDC Copeland; and the beta-glucan content was higher than 2008 QS samples but significantly lower than 2007 QS samples.

Table 3.4. Malt analysis and quality evaluation for 2008 QS CDC Copeland barley samples

Parameter	2009 QS CDC Copeland		2008 QS CDC Copeland	2007 QS CDC Copeland
	#1	#2	Mean	Mean
Pilot-malting Sample	#1	#2	Mean	Mean
Malt moisture, %	3.6	4.2	4.15	3.8
Friability, %	87.5	87.1	91.6	92.0
Fine-extract, %	80.9	80.7	80.9	80.4
Coarse-extract, %	80.4	80.2	78.9	79.5
F/C Difference, %	0.5	0.5	1.5	0.9
Soluble protein, %	5.19	5.34	5.02	5.03
Total protein, %	11.01	11.66	11.25	11.7
Kolbach Index, %	47.1	45.8	44.8	43.2
Beta-Glucan, ppm	91	114	90	154
Viscosity, cps	1.39	1.42	1.42	1.42
Diastatic power, °L	157	134	139	136
α-Amylase, D.U.	61.6	48.2	56.2	54.3
Wort colour, ASBC	1.80	1.89	1.74	1.78
Wort pH	6.00	5.84	5.89	5.95
Fan, mg/L	265	249	232	196



Malting Summary

- **General modification:** The values for friability, F/C difference, beta-glucan content, and soluble protein all suggested that these two QS CDC Copeland barley samples produced malts with very good modification.
- **Extract yield and enzyme levels:** In comparison with the averages of 2008 and 2007 QS samples, the malts produced from 2009 QS CDC Copeland samples exhibited extract yield similar to 2008 QS sample but slightly higher than 2007 QS sample. Their α -amylase level was similar to 2008 and 2007 QS samples but its diastatic power was higher.
- **Soluble protein, free amino nitrogen (FAN) and malt colour:** The malts produced from these 2009 QS samples exhibited slightly higher protein modification than that of 2008 and 2007 QS sample as indicated by higher Kolbach Index. The malts also developed higher level of FAN and slightly higher malt colour.

Comments on the malting process

During the malting process, no difficulties were recorded for these two QS CDC Copeland barley samples.

2009 CDC Copeland barley could be processed under normal Canadian two-row malting barley processing conditions since it has low protein content and showed slight water sensitivity.

At steep, target a steep-out moisture of 44-45% and over 85% chitting rate. The steeping cycle should consist of 2 or 3 wet periods at 15-16 °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 higher than that used for processing AC Metcalfe and CDC Kendall (82-85 °C) since CDC Copeland has a tendency of producing lower malt color.



CDC Kendall

At steep, this 2008 QS Kendall barley sample obtained satisfactory steep-out moisture and excellent chitting rate (Table 3.5). During germination this samples showed good growth of acrospires and normal progress of modification.

Table 3.5. Steep-out moisture, chitting rate and acrospire growth of 2009 QS CDC Kendall barley

CDC Kendall #1	Steep-out moisture (%)		Chitting rate (%)		
	43.0		100		
Acrospire growth					
	0-1/4 (%)	1/4-1/2 (%)	1/2-3/4 (%)	3/4-1 (%)	>1 (%)
24 hours	45	55	0	0	0
48 hours	0	40	60	0	0
72 hours	0	40	30	30	0
96 hours	0	5	15	65	15

Under the trial processing conditions, this CDC Kendall produced malt with a well balanced quality profile, and the malt recorded high friability, low F/C difference and very low beta-glucan content. In comparison with the 2008 and 2007 QS CDC Kendall samples, this 2009 QS Kendall malt had higher friability, significantly higher extract yield, higher soluble protein, and significantly lower beta-glucan content. Its diastatic power was significantly higher than 2008 and 2007 QS samples, while its α -amylase was lower than 2007 QS sample but higher than 2008 QS sample.

**Table 3.6. Malt analysis and quality evaluation for 2009 QS CDC Kendall barley samples**

Parameter	2009 QS CDC Kendall	2008 QS CDC Kendall	2007 QS CDC Kendall
Malt moisture, %	3.7	4.6	3.9
Friability, %	90.5	86.9	94.5
Fine-extract, %	81.2	80.5	79.7
Coarse-extract, %	80.7	79.3	79.1
F/C Difference, %	0.5	1.2	0.6
Soluble protein, %	5.2	5.28	5.33
Total protein, %	11.0	12.2	12.4
Kolbach Index, %	47.1	43.6	43.4
Beta-Glucan, ppm	86	137	95
Viscosity, cps	1.41	1.43	1.39
Diastatic power, °L	193	162	173
α -Amylase, D.U.	64.1	57.1	69.7
Wort colour, ASBC	1.88	1.91	1.92
Wort pH	5.99	5.93	5.94
Fan, mg/L	247	235	208

Malting Summary

- **General modification:** The values for friability, F/C difference, beta-glucan content, and soluble protein content all suggested that this CDC Kendall barley sample produced malt with very good modification.
- **Extract yield and enzyme levels:** In comparison with 2008 and 2007 QS samples, the malt produced from this 2009 Kendall sample exhibited extract yield significantly higher. Its α -amylase level was lower than 2007 QS but higher than 2008 and 2007 QS sample, and its diastatic power was significantly higher than 2008 and 2007 QS samples.
- **Free amino nitrogen (FAN) and malt colour:** The malt produced from this 2009 QS Kendall sample exhibited slightly higher protein modification than 2008 and 2007 QS sample as indicated by higher Kolbach Index. The malt also developed higher level of FAN and slight lower malt colour.



Comments on the malting process

During the malting process, no difficulties were recorded for this CDC Kendall sample.

2009 CDC Kendall can be processed under normal malting conditions used for Canadian two-row malting barley since it has lower protein content and showed no significant water sensitivity.

In steep target a steep-out moisture content of 44-45% and over 85% chitting rate. The steeping cycle should consist of 2 or 3 wet periods at 15-16 °C.

In germination avoid high temperature and excessive watering to control excessive acrospire growth and protein breakdown.

In kilning the curing temperature could be set to that similar to used for processing AC Metcalfe (80-82 °C) since CDC Kendall has a tendency of producing high malt colour.



Newdale

2008 QS Newdale barley obtained satisfactory steep-out moisture content and excellent chitting rate at steep (Table 3.7). During germination, it showed good acrospire growth (but slower than expected), and decent progress of modification.

Table 3.7 Steep-out moisture, chitting rate and acrospire growth of 2009 QS Newdale barley

Newdale		Steep-out moisture (%)		Chitting rate (%)	
		45.18		100	
Acrospire growth					
	0-1/4 (%)	1/4-1/2 (%)	1/2-3/4 (%)	3/4-1 (%)	>1 (%)
24 hours	15	60	20	5	0
48 hours	0	35	50	15	0
72 hours	0	15	50	35	0
96 hours	0	0	15	85	0

The 2009 QS Newdale barley sample produced malt with a decent quality profile. Its' beta-glucan content was higher than desired. The malt exhibited high friability, low F/C difference, good soluble protein, high FAN, acceptable enzymes and malt color (Table 3.8). Compared with the 2008 and 2007 QS Newdale samples, the malt produced from 2009 QS Newdale exhibited comparable overall quality.



Table 3.8. Malt analysis and quality evaluation for 2009 QS Newdale barley

Parameter	2009 QS Newdale	2008 QS Newdale	2007 QS Newdale
Malt moisture, %	3.8	4.3	4.6
Friability, %	91.3	91.1	88.6
Fine-extract, %	79.8	79.6	78.2
Coarse-extract, %	79.3	79.1	78.0
F/C Difference, %	0.5	0.5	0.2
Soluble protein, %	5.02	4.75	4.91
Total protein, %	11.16	12.18	13.2
Kolbach Index, %	44.9	38.9	37.3
Beta-Glucan, ppm	156	79	155
Viscosity, cps	1.38	1.39	1.43
Diastatic power, °L	126	141	132
α-Amylase, D.U.	61.0	64.0	54.2
Wort colour, ASBC	1.90	1.87	1.79
Wort pH	6.02	5.85	5.78
Fan, mg/L	223	189	179

Malting Summary

- **General modification:** The values for friability, F/C difference, and soluble protein content all suggest that this 2009 QS Newdale barley sample produced malt with good modification; however, its beta-glucan content suggested the malt was slightly under-modified.
- **Extract yield and enzyme levels:** In comparison with the 2008 and 2007 QS Newdale samples, the malt produced from this 2009 QS sample exhibited slightly higher extract yield. Its diastatic power were lower than 2008 and 2007 QS barley samples, and α-Amylase level was slightly lower than 2008 QS sample but significantly higher than 2007 QS sample.
- **Soluble protein, free amino nitrogen (FAN) and malt colour:** The malt produced from this Newdale barley sample exhibited higher protein modification than that in 2008 and 2007 crop years as indicated by higher Kolbach Index. The malt also developed higher levels of FAN than the 2008 and 2007 QS samples. Its malt colour was slightly higher than the 2008 and 2007 QS samples.



Comments on the malting process

During the malting process, no difficulties were recorded for this Newdale QS barley sample.

2009 Newdale barley can be processed under normal Canadian two-row malting conditions since it exhibits low protein content and showed only minor water sensitivity.

In steep target a steep-out moisture content of 44-45% and over 85% chitting rate. The steeping cycle should consist of 2 or 3 wet periods at 15-16 °C.

In germination, please make sure to have adequate green malt moisture content to encourage acrospires growth and beta-glucan breakdown.

In kilning the curing temperature could be set to that used for processing CDC Copeland (82-85 °C) since in the malting trials high malt color formation was not recorded.

In conclusion, under the trial malting conditions all the 2009 QS barley samples exhibited good water uptake and good chitting rate at steep, and showed good growth during germination. The malts produced all showed satisfactory values in friability, extract level, soluble protein, enzymes, FAN and color; while beta-glucan content was generally lower in all the malts but Newdale. Its malt showed beta-glucan content higher than desired. It may need some special attentions in process to lower beta-glucan content. Compared with the 2008 QS barley samples, all 2009 QS barley samples showed better overall malting performance and produced malts with better or comparable quality.



4. Pilot-brewing Trials

Malts produced from the malting trials were pilot brewed in CMBTCs 300L Pilot Brewery. Malts from the two 2009 QS Metcalfe and two 2009 QS Copeland trials were brewed separately. Consequently, the brewing results for these two varieties are presented as the averages of the two brewing trials. The Kendall and Newdale malts were from single malting trials. The following is the mashing and fermentation conditions for the brewing trials with the 2009 QS sample malts:

Mash Tun

- 100% malt brew – 36 to 40 kg of malt and 125L 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 5 minutes, vorlauf for 10 minutes
- Rakes at 20 cm above bottom, on slow for entire lautering
- 25L underlet
- 100L 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, cooled to 1.5°C and then transferred to storage
- Stored at -0.5 °C for 10 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

TECHNICAL REPORT

The brewing results are given in Tables 4, 5, 6, 7, 8, 9, 10, and 11.

Table 4. Malt grist composition (%) for the brewing trials

Sieve	AC Metcalfe	CDC Copeland	CDC Kendall	Newdale
#10	3.55	2.76	3.19	3.93
#14	7.54	8.24	9.46	9.02
#20	27.38	24.20	28.86	25.00
#30	20.31	20.68	19.26	19.85
#60	22.27	23.42	20.40	21.71
#100	15.28	19.36	17.77	17.80
On pan	3.63	1.30	1.03	2.65

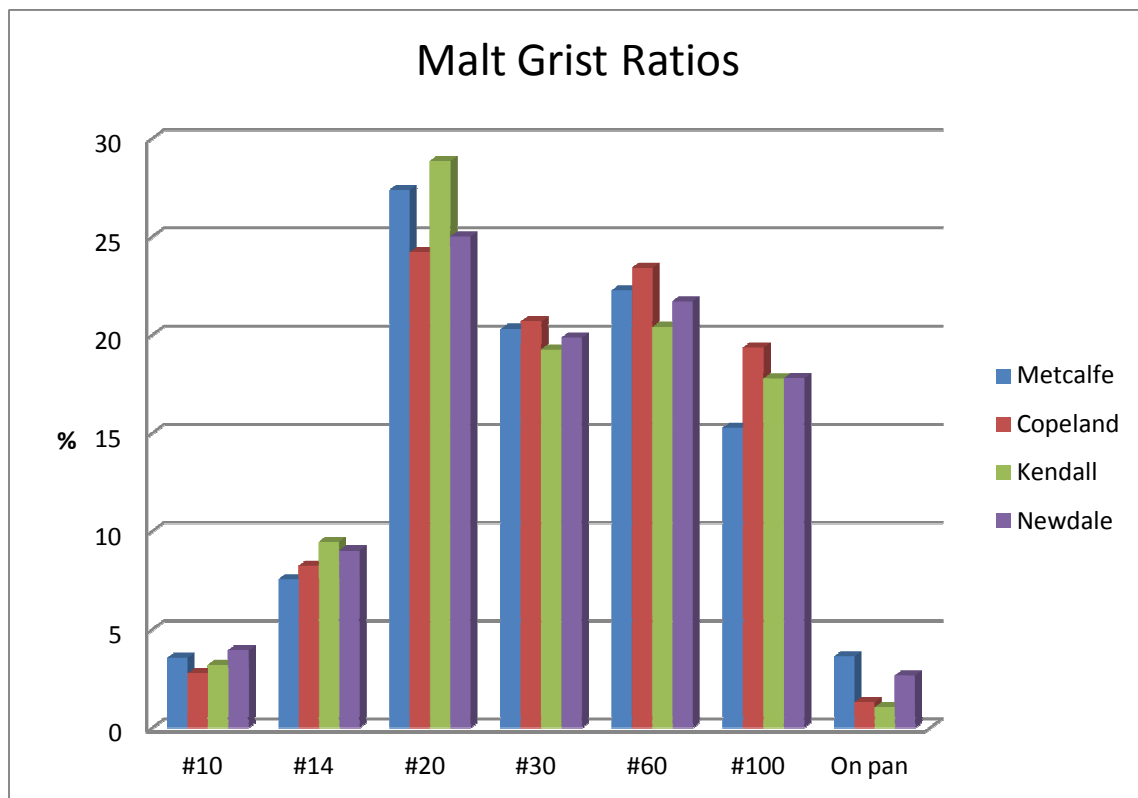


Figure 1: Malt Grist Ratios for the 2009 samples

There were no problems recorded for milling the 2009 quality scoop derived malt, although some variations in malt grist compositions among the barley varieties were observed (Table 4, Figure 1). However, the differences were not large enough to affect brewing performance.



Table 5. Brewhouse observations for the brewing trials for 2009.

Parameter	AC Metcalfe*	CDC Copeland*	CDC Kendall	Newdale
Conversion time (min.)	8.5	10	5	6
Time to clear (min.)	6.5	6.3	6	5.5
Lautering time (min.)	58.5	58	58	59
Malt Material Yield (%)	89.2	88.2	89.8	91.1
Wort pH	5.24	5.10	5.12	5.15
Wort Colour (SRM)	3.8	4.4	3.69	3.63

*Averages of 2 brewing trials

In the brewhouse, the malts for the four barley varieties showed different conversion times, and their conversion times were typically shorter than in the previous three crop years (Table 6). Among the tested malts, 2009 QS CDC Kendall showed the shortest conversion time (5 min). That was closely followed by Newdale (6 min). The other two varieties were comparable with conversion times ranging from 8.5 minutes for AC Metcalfe to 10 minutes for CDC Copeland. Time for worts to clear to less than 100 FTU was excellent and typically shorter than 7 minutes. Lautering times for all the samples were comparable (between 58 and 59 minutes). Malt Material Yields for all the samples were very good, ranging from 88.2% for CDC Copeland to 91.1% for Newdale. Wort colour was the lowest for the Newdale and Highest for the CDC Copeland sample. The pH values were typical for all of the trial wort samples.

Table 6. Conversion times for 100% malt brews with 2009 crop, versus 2008, 2007 and 2006 quality scoop.

	QS 2009	QS 2008	QS 2007	QS 2006
AC Metcalfe	8.5	10.5	25	16
CDC Copeland	10	11	18	16
CDC Kendall	5	7	19	15
Newdale	6	10	12*	-

*Thinner mash

When Lautering times from the 2009 QS were compared to 2008 QS all of the 2009 QS samples were slightly faster. When compared to 2007 QS and 2006 QS the samples from 2009 QS were slower or comparable to previous years averages (Table 7).



Table 7. Lautering times for 100% malt brews with 2009 crop, versus 2008, 2007 and 2006 quality scoop.

	QS 2009	QS 2008	QS 2007	QS 2006
AC Metcalfe	58.5	62	54	57
CDC Copeland	58	61.5	57	62
CDC Kendall	58	60	55	54
Newdale	59	59	55	-

Brewhouse yields for the 2009 QS samples were excellent for CDC Kendall and Newdale, and good for the other two varieties. AC Metcalfe and CDC Copeland showed slightly lower values than in previous three years (table 8).

Table 8. Brewhouse yields for 2009 crop, versus 2008, 2007 and 2006 quality scoop.

	QS 2009	QS 2008	QS 2007	QS 2006
AC Metcalfe	71.1	73.3	74.1	73.3
CDC Copeland	70.8	74.2	72.2	72.5
CDC Kendall	72.5	71.2	72.6	71.3
Newdale	72.3	71.3	70.9	-

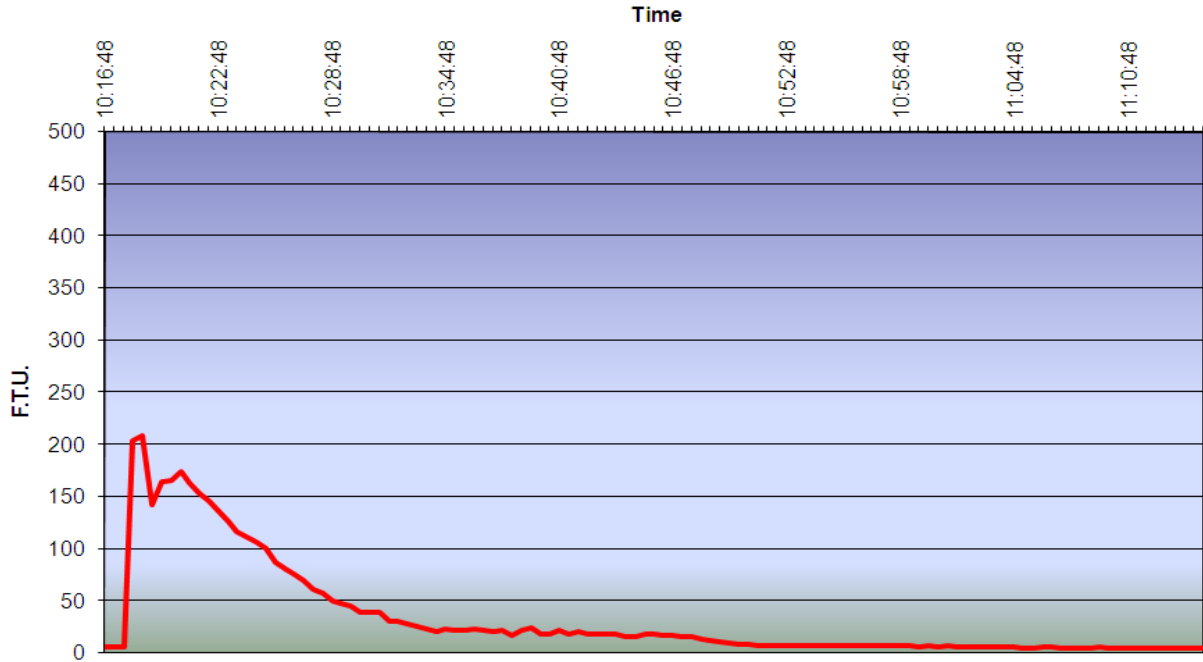
Normal sugar spectra were exhibited for all 2009 QS samples (Table 9). The wort carbohydrate spectrum was comparable for all 2009 QS samples wort samples. Newdale recorded slightly lower levels for all the sugars because of the thinner mash, but the ratios were similar to the other varieties.

Table 9. Wort sugar concentration for the brewing trials (mg/L)

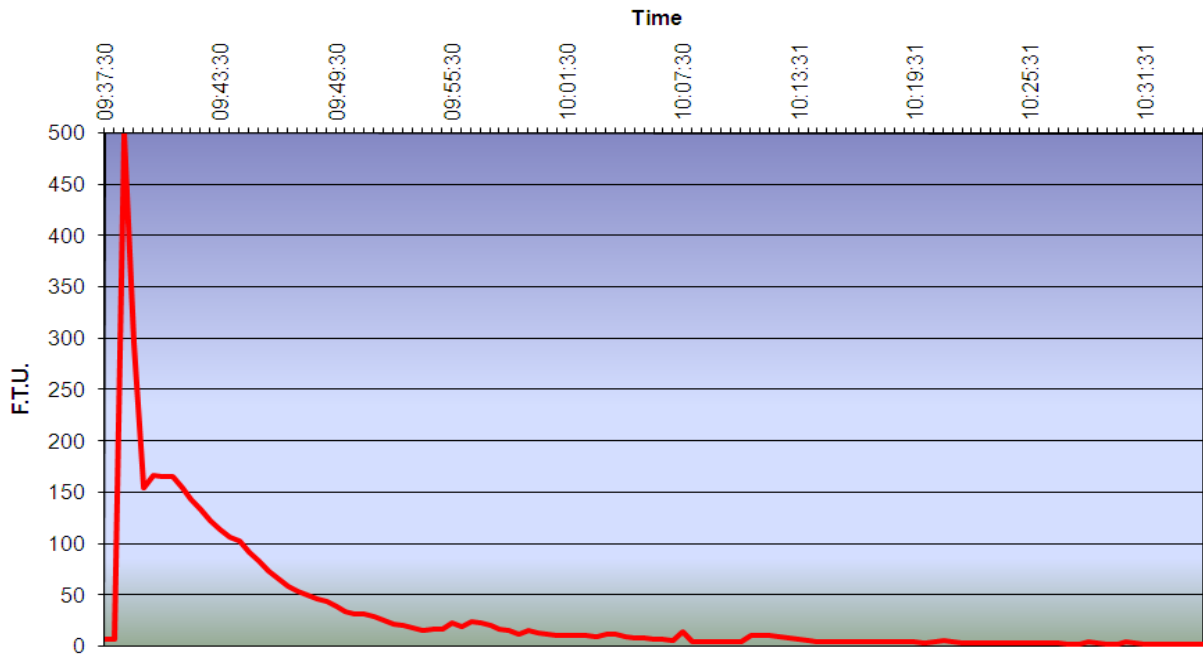
Carbohydrate	Metcalfe	Copeland	Kendall	Newdale
Maltotetrose	2.85	3.77	3.50	3.30
Maltotriose	14.58	16.75	15.9	14.37
Maltose	59.74	60.65	63.98	54.25
Glucose	12.92	14.20	13.06	11.86
Fructose	4.20	4.50	3.62	3.62



PB-09-031: Runoff Lautertun Turbidity



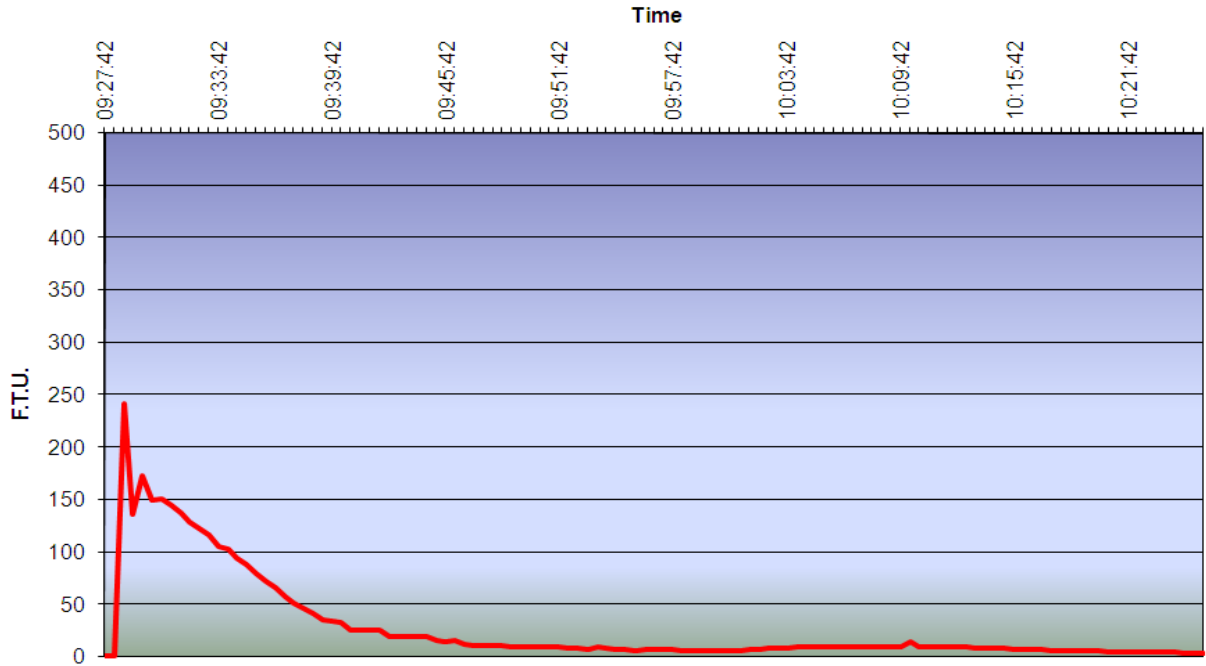
PB-09-032: Runoff Lautertun Turbidity



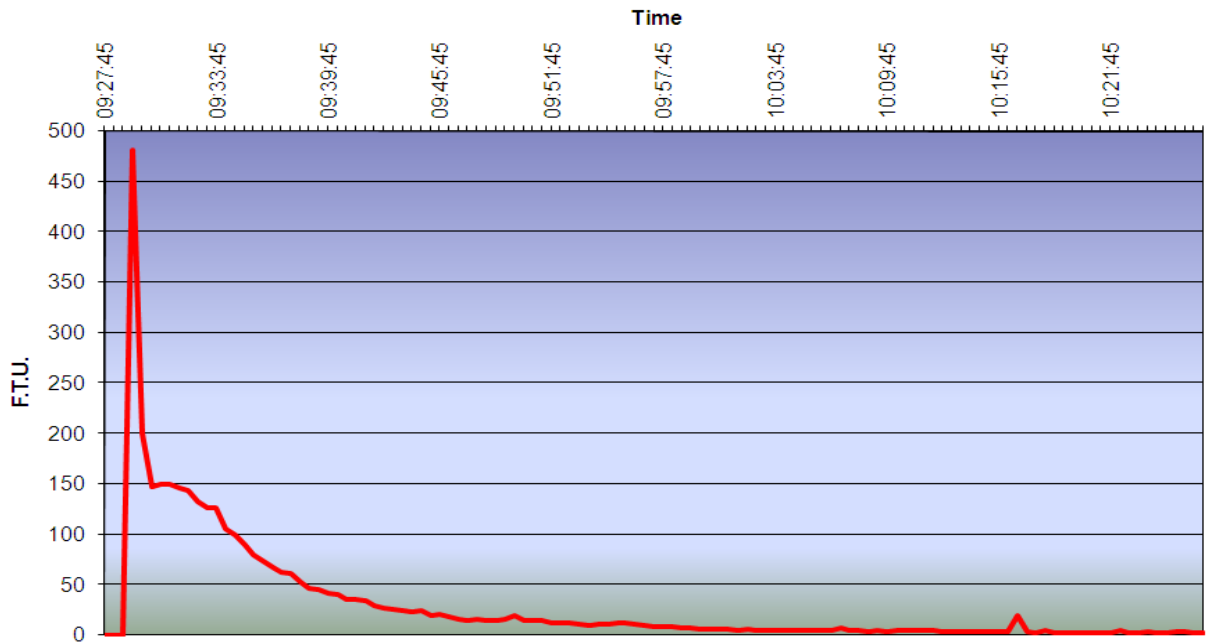
Figures 2 and 3: Runoff turbidity profile for the 2009 QS AC Metcalfe and CDC Copeland malts respectively.



PB-09-036: Runoff Lautertun Turbidity



PB-09-034: Runoff Lautertun Turbidity



Figures 4 and 5: Runoff turbidity profile for the 2009 QS CDC Kendall and Newdale malts respectively.



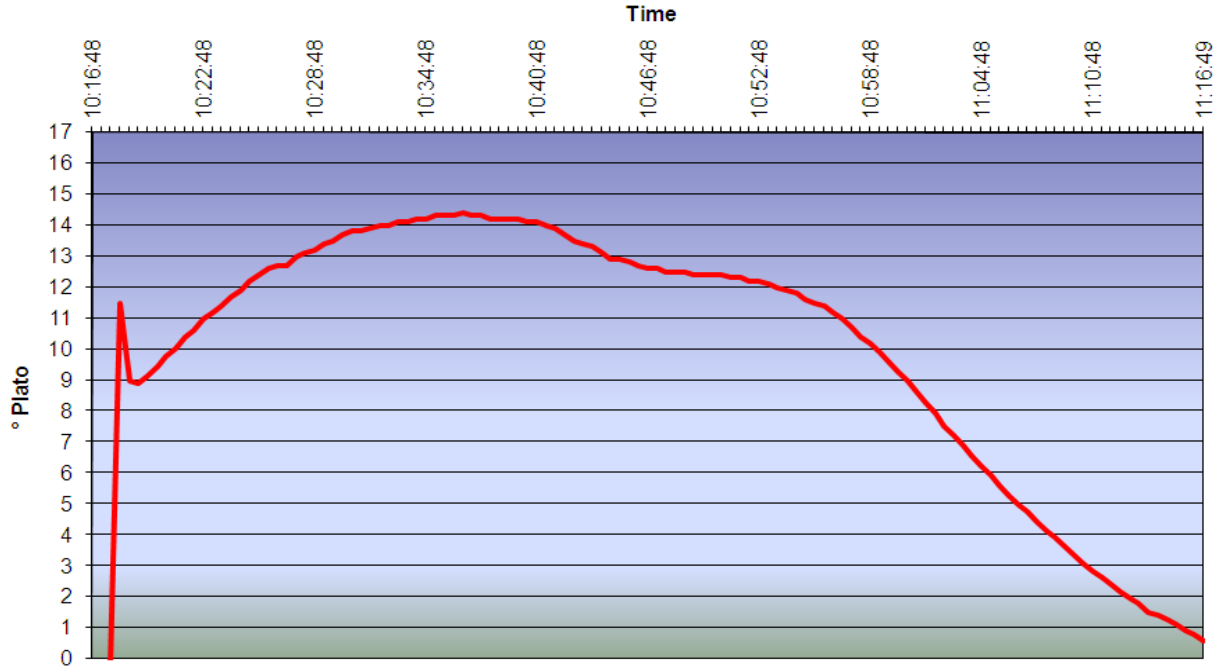
CMBTC
CANADIAN MALTING BARLEY TECHNICAL CENTRE

TECHNICAL REPORT

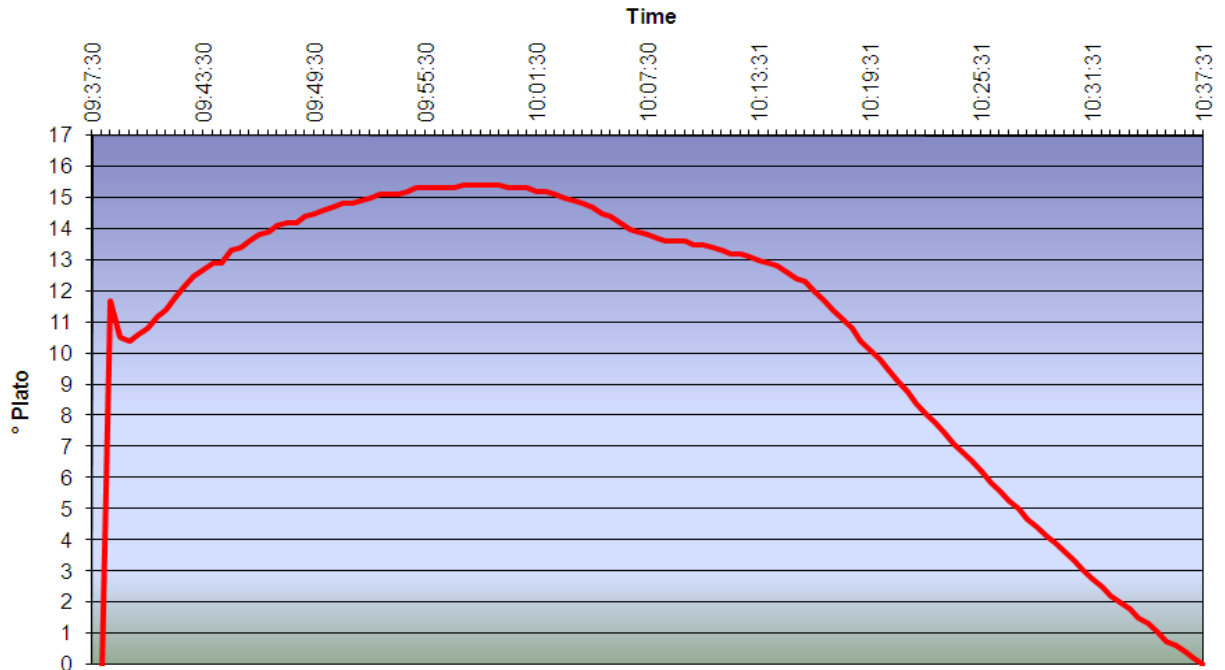
Runoff turbidities for the test malts were within the normal range for the 2009 QS produced malts (Figures 2 – 5). Clarity below 100 FTU was obtained typically in less than 7 minutes for all four malt samples. The wort clarity curve recorded for all test varieties was normal, with AC Metcalfe and CDC Kendall showing the lowest initial turbidity.



PB-09-031: Runoff Lautertun Specific Gravity



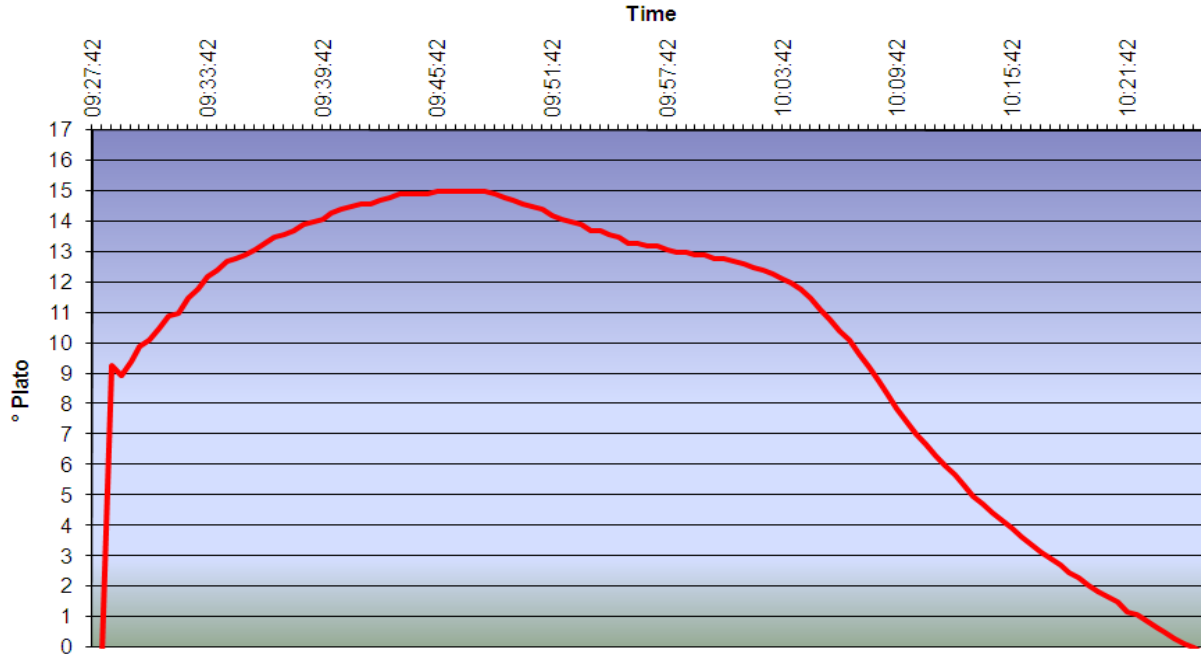
PB-09-032: Runoff Lautertun Specific Gravity



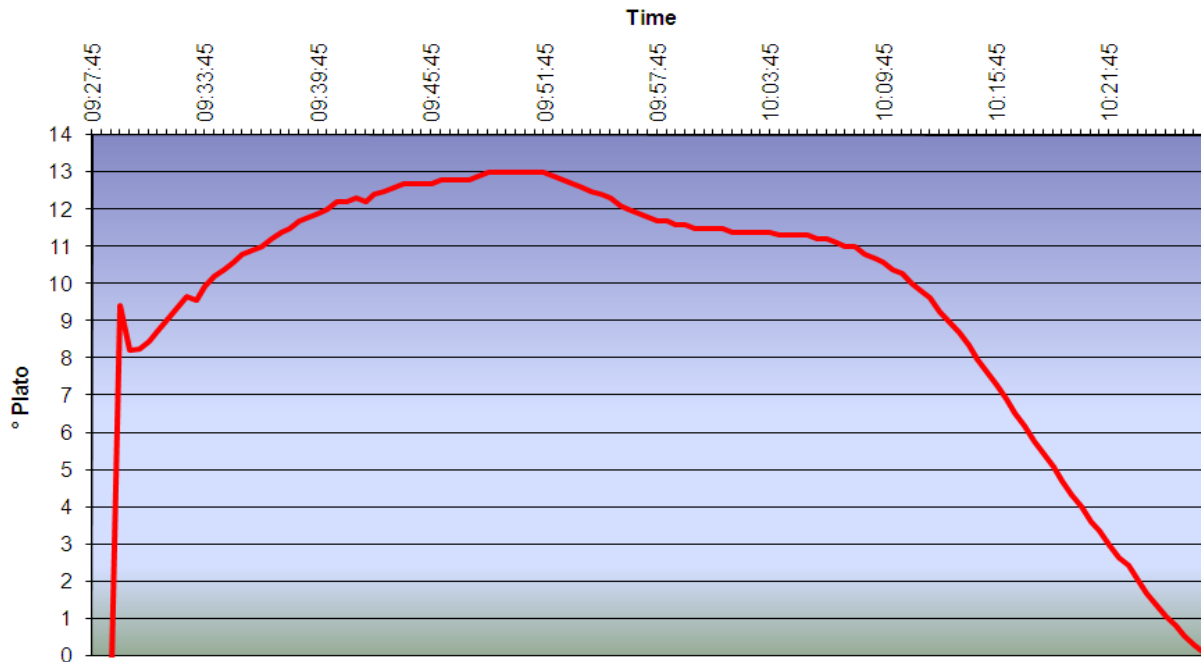
Figures 6 and 7: Runoff specific gravity profile for the 2009 QS AC Metcalfe and CDC Copeland malts respectively.



PB-09-036: Runoff Lautertun Specific Gravity



PB-09-034: Runoff Lautertun Specific Gravity



Figures 8 and 9: Runoff specific gravity profile for the 2009 QS CDC Kendall and Newdale malts respectively.



Runoff specific gravity profiles for the test malts were within the normal range for the 2009 QS samples (Figures 6 – 9).

Table 10: Fermentation observations for the brewing trials

Brews	AC Metcalf	CDC Copeland	CDC Kendall	Newdale
Attenuation Limit (%)	85.6	87.3	89.5	82.9

The fermentabilities of the wort produced from the 2009 samples (Table 10) were very good. As recorded in past trials Kendall worts exhibited the highest fermentability of the varieties.

Table 11. Final beer analysis

Parameter	AC Metcalf	CDC Copeland	CDC Kendall	Newdale
Apparent Extract (Plato)	1.61	1.57	1.21	1.29
Real Extract (Plato)	3.29	3.46	3.04	3.00
Alcohol, %	4.91	5.31	5.12	4.80
Color, (ASBC)	3.23	3.26	2.84	2.57
pH	4.28	4.30	4.22	4.20
Foam (sec)	210	208	177	208
Initial Turbidity (FTU)	18.6	22.3	13.3	12.7
Chill Turbidity (FTU) 24 Hr	19.1	22.4	14.0	12.9
Forcing Turbidity (FTU)	47.7	101	148	284
IBU	11.94	12.4	9.67	9.52

All malts produced beer with acceptable quality. All the beers produced from 2009 crop QS showed generally low colours with Newdale showing the lowest value. Beer produced from AC Metcalfe offered the highest foam value. The initial and chill turbidity for all 2009 QS samples were exceptionally good, indicating good physical and colloidal stability.



CMBTC
CANADIAN MALTING BARLEY TECHNICAL CENTRE

TECHNICAL REPORT

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