

Cool
Climate
Oenology &
Viticulture
Institute

Brock University

Growing Season Weather Patterns Impact on Vine Hardiness

Kevin W. Ker, PhD

Professional Affiliate and Research Associate

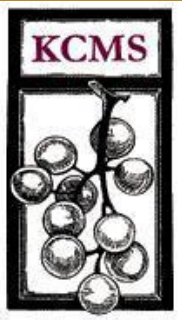
Cool Climate Oenology and Viticulture Institute,
Brock University, St. Catharines ON Canada

KCMS Applied Research and Consulting, Fenwick ON Canada



Overview

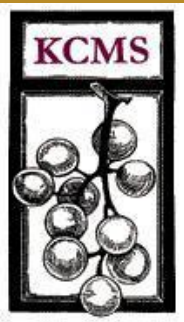
- Cold hardiness of grapevines is the main limiting factor for growing grapes in Ontario
- Winter Injury is one of the greatest threats to the success of our industry
- Vine health and winter hardiness is directly influenced by the weather patterns of the growing season





Vine Hardiness

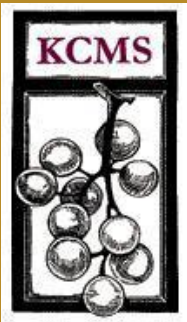
- Ability to withstand different freezing temperatures at different times of the year
- Concept of optimizing genetic potential versus increasing hardiness
- Influenced by many factors
 - Weather patterns (early, mid, and late season)
 - Crop loads
 - Inherent vine hardiness
 - Vine health

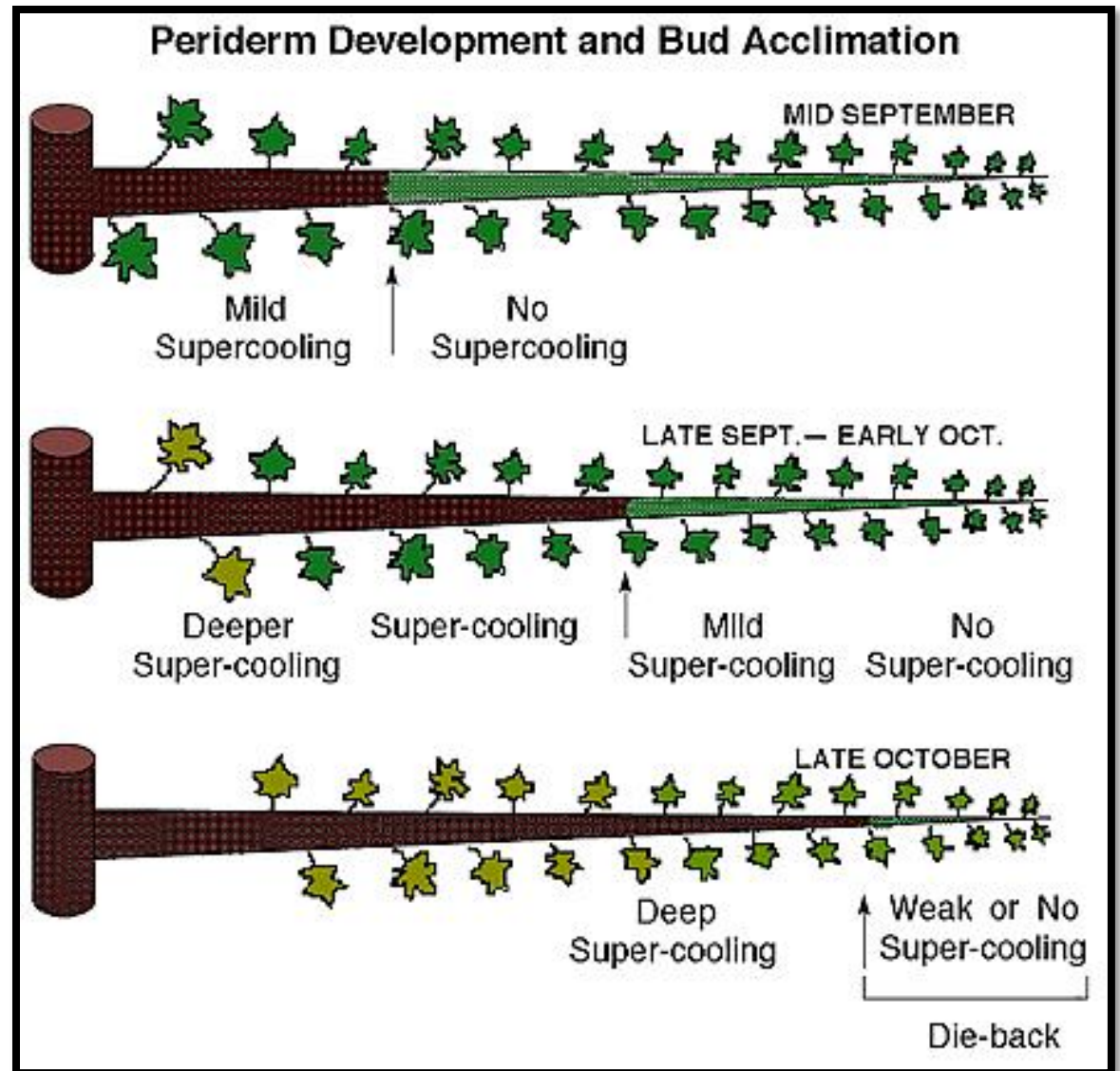




Acclimation

- A reversible change in the morphology or physiology of an organism in response to environmental change





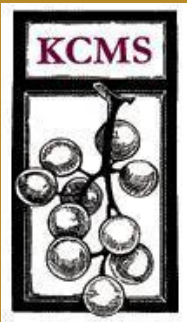
From Wine East 2001





How has the weather influenced this acclimation and hardiness

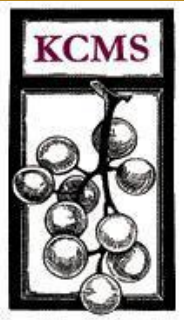
- Consider temperature and precipitation events throughout the season and during key periods
 - From Fruit Set to Veraison
 - From Veraison to Harvest (or Leaf Drop)





How do most remember weather?

- **Most people remember 3 years of weather**
But not consecutively !
- **The BEST YEAR**
- **THE WORST YEAR**
- **LAST YEAR**





Cool
Climate
Oenology &
Viticulture
Institute

Brock University

Growing Season Summary Chardonnay (Queenston)

YEAR	BUD BREAK	BLOOM	VERAISON	HARVEST (Chard.)	GDD base 10C	PPT mm
2007	May 10	June 16	August 19	October 1	1647	319
2008	May 14	June 23	August 24	October 15	1426	427
2009	May 15	June 27	August 27	October 19	1266	585
2010	May 6	June 14	August 15	October 1	1662	526
2011	May 17	June 24	August 22	October 12	1589	629





Cool
Climate
Oenology &
Viticulture
Institute

Brock University

Growing Season Summary Chardonnay (Queenston)

YEAR	BUD BREAK	BLOOM	VERAISON	HARVEST (Chard.)	GDD base 10C	PPT mm
2007	May 10	June 16	August 19	October 1	1647	319
2008	May 14	June 23	August 24	October 15	1426	427
2009	May 15	June 27	August 27	October 19	1266	585
2010	May 6	June 14	August 15	October 1	1662	526
2011	May 17	June 24	August 22	October 12	1589	629



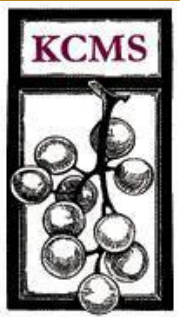


Cool
Climate
Oenology &
Viticulture
Institute

Brock University

Growing Season Summary Chardonnay (Queenston)

YEAR	BUD BREAK	BLOOM	VERAISON	HARVEST (Chard.)	GDD base 10C	PPT mm
2007	May 10	June 16	August 19	October 1	1647	319
2008	May 14	June 23	August 24	October 15	1426	427
2009	May 15	June 27	August 27	October 19	1266	585
2010	May 6	June 14	August 15	October 1	1662	526
2011	May 17	June 24	August 22	October 12	1589	629





Cool
Climate
Oenology &
Viticulture
Institute

Brock University

Growing Season Summary Chardonnay (Queenston)

YEAR	BUD BREAK	BLOOM	VERAISON	HARVEST (Chard.)	GDD base 10C	PPT mm
2007	May 10	June 16	August 19	October 1	1647	319
2008	May 14	June 23	August 24	October 15	1426	427
2009	May 15	June 27	August 27	October 19	1266	585
2010	May 6	June 14	August 15	October 1	1662	526
2011	May 17	June 24	August 22	October 12	1589	629



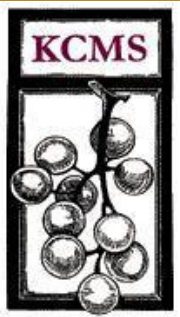


Cool
Climate
Oenology &
Viticulture
Institute

Brock University

Precipitation April to June 2007-2011 (mm)

	April		May		June	
	Total	# Days	Total	# Days	Total	# Days
2007	58.4	18	27.2	8	36.0	8
2008	39.8	7	62.8	17	36.8	10
2009	102.4	13	50.2	13	90.6	10
2010	51.6	7	60.0	11	154.2	15
2011	129.2	17	148.8	18	57.8	9



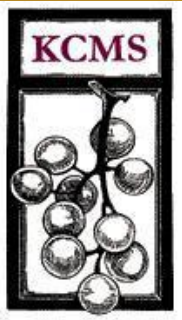
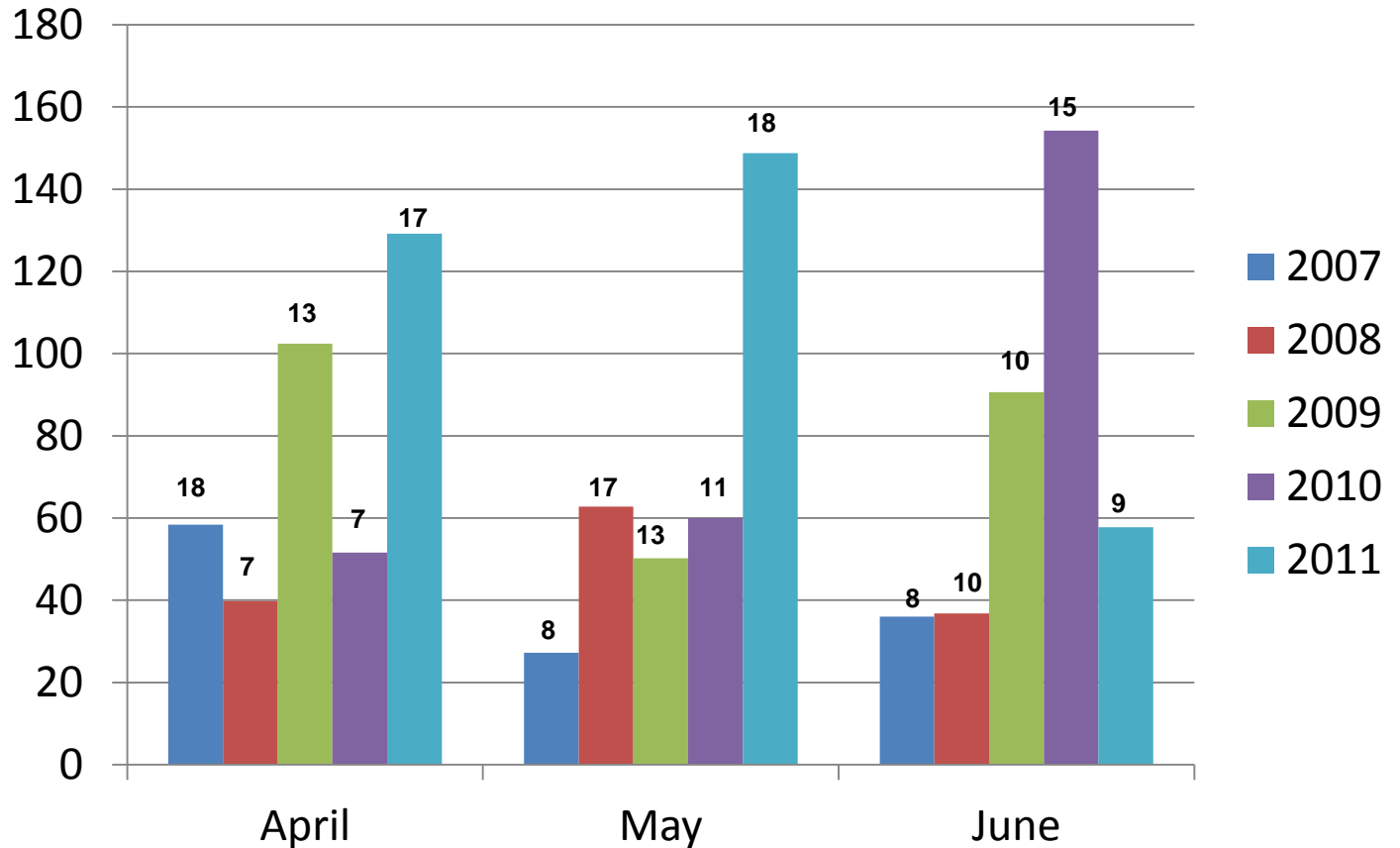


Cool
Climate
Oenology &
Viticulture
Institute

Brock University

Precipitation 2007-2011

April, May June (mm)



	2007	2008	2009	2010	2011
Bloom	June 16	June 23	June 27	June 14	June 24



Cool
Climate
Oenology &
Viticulture
Institute

Brock University

Precipitation 2007-2011

June to August (mm)

	June		July		August	
	Total	# Days	Total	# Days	Total	# Days
2007	36.0	8	58.4	11	37.8	12
2008	36.8	10	82.6	13	55.2	15
2009	90.6	10	102.8	12	134.4	12
2010	154.2	15	68.0	8	63.2	11
2011	57.8	9	30.0	5	70.8	7



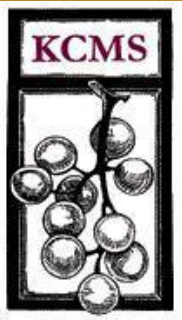
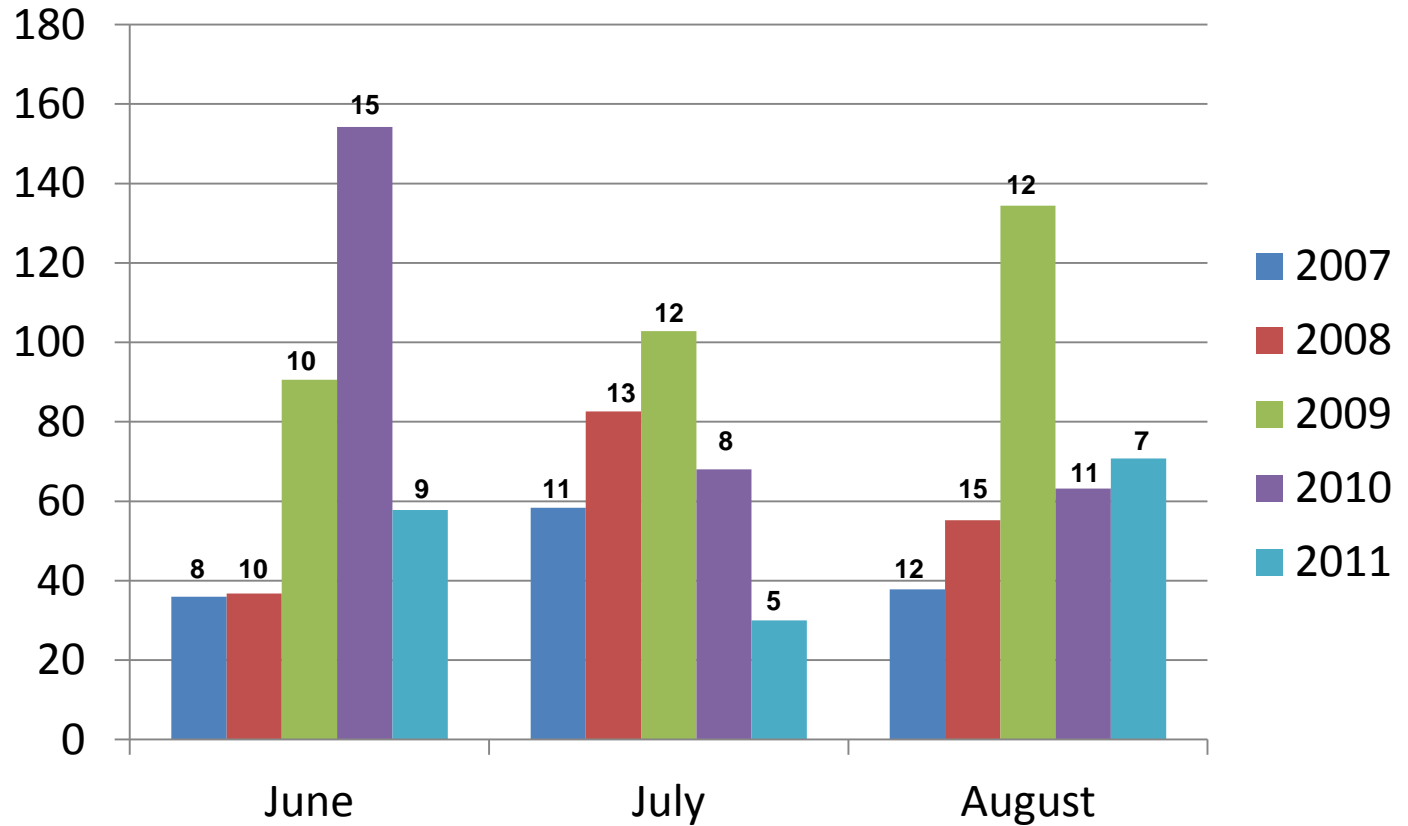


Cool
Climate
Oenology &
Viticulture
Institute

Brock University

Precipitation 2007-2011

June to August (mm)



	2007	2008	2009	2010	2011
Fruit Set	June 20	June 28	July 02	June 18	June 29
Veraison	August 19	August 24	August 27	August 15	August 22

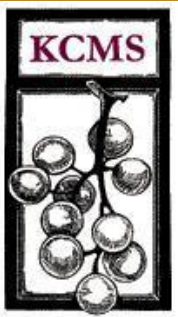


Cool
Climate
Oenology &
Viticulture
Institute

Brock University

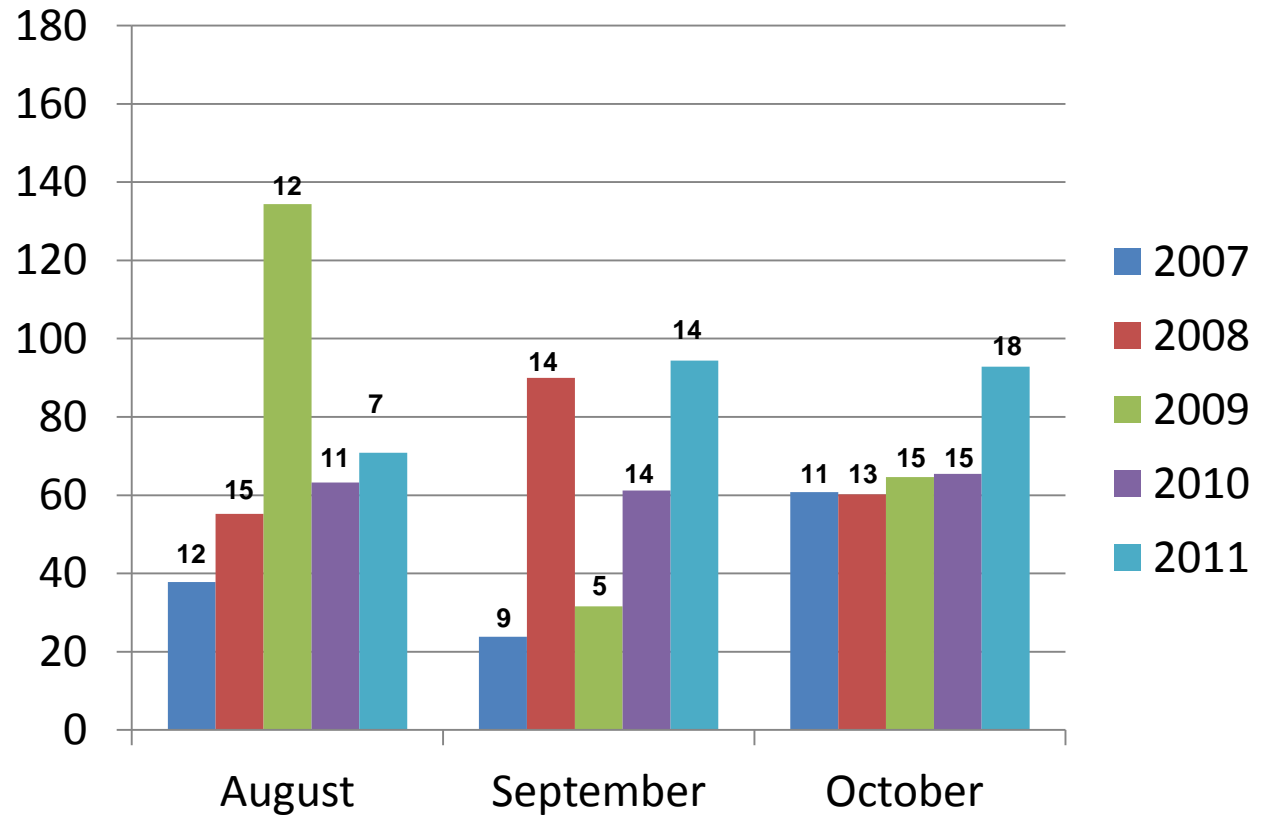
Precipitation 2007-2011 August to October (mm)

	August		September		October	
	Total	# Days	Total	# Days	Total	# Days
2007	37.8	12	23.8	6	60.8	12
2008	55.2	15	90.0	13	60.2	11
2009	134.4	12	31.6	12	64.6	14
2010	63.2	11	61.2	12	65.4	16
2011	70.8	7	94.4	16	92.8	21





Precipitation 2007-2011 August to October (mm)



	2007	2008	2009	2010	2011
Veraison	August 19	August 24	August 27	August 15	August 22
Harvest	October 1	October 15	October 19	October 1	October 12

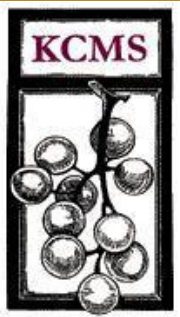


Cool
Climate
Oenology &
Viticulture
Institute

Brock University

Growing Degree Days April - May 2007-2011 (Base 10 C)

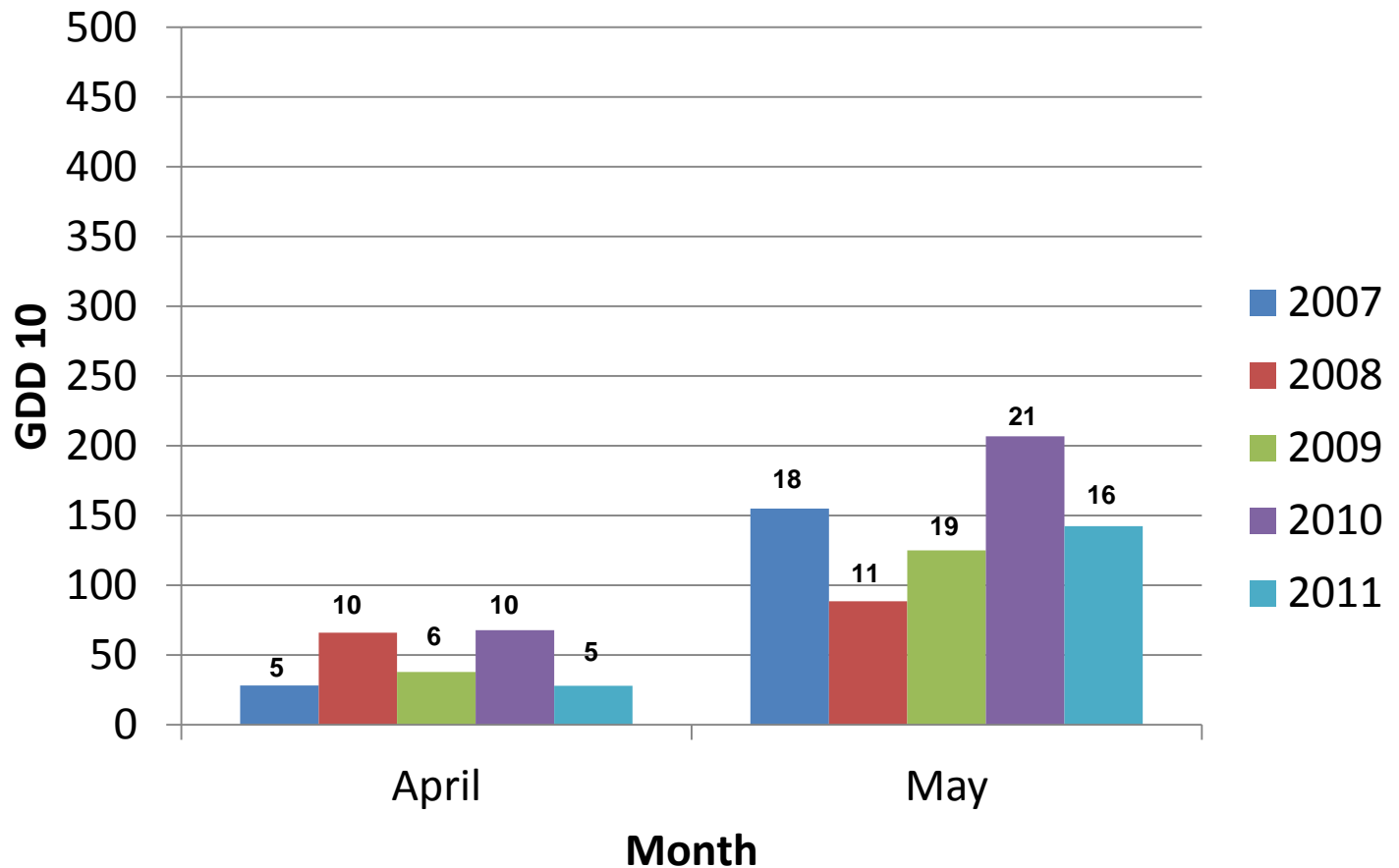
	April		May	
	GDD	#D >20	GDD	#D >20
2007	28.3	5	155.1	18
2008	66.0	10	88.7	11
2009	37.9	6	125.1	19
2010	67.9	10	206.9	21
2011	28.0	5	142.4	16





Growing Degree Days (10C) - SPRING

Monthly GDD10 & # of Days > 20°C





Cool
Climate
Oenology &
Viticulture
Institute

Brock University

Growing Degree Days (Base 10C) June-August 2007-2011

	June		July		August	
	GDD	#D >30	GDD	#D >30	GDD	#D >30
2007	332.8	11	345.0	4	372.4	11
2008	335.2	7	371.5	8	305.5	1
2009	228.9	2	292.3	0	339.5	6
2010	306.6	0	419.5	10	397.3	11
2011	295.1	4	448.5	23	366.8	7

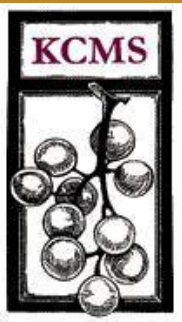
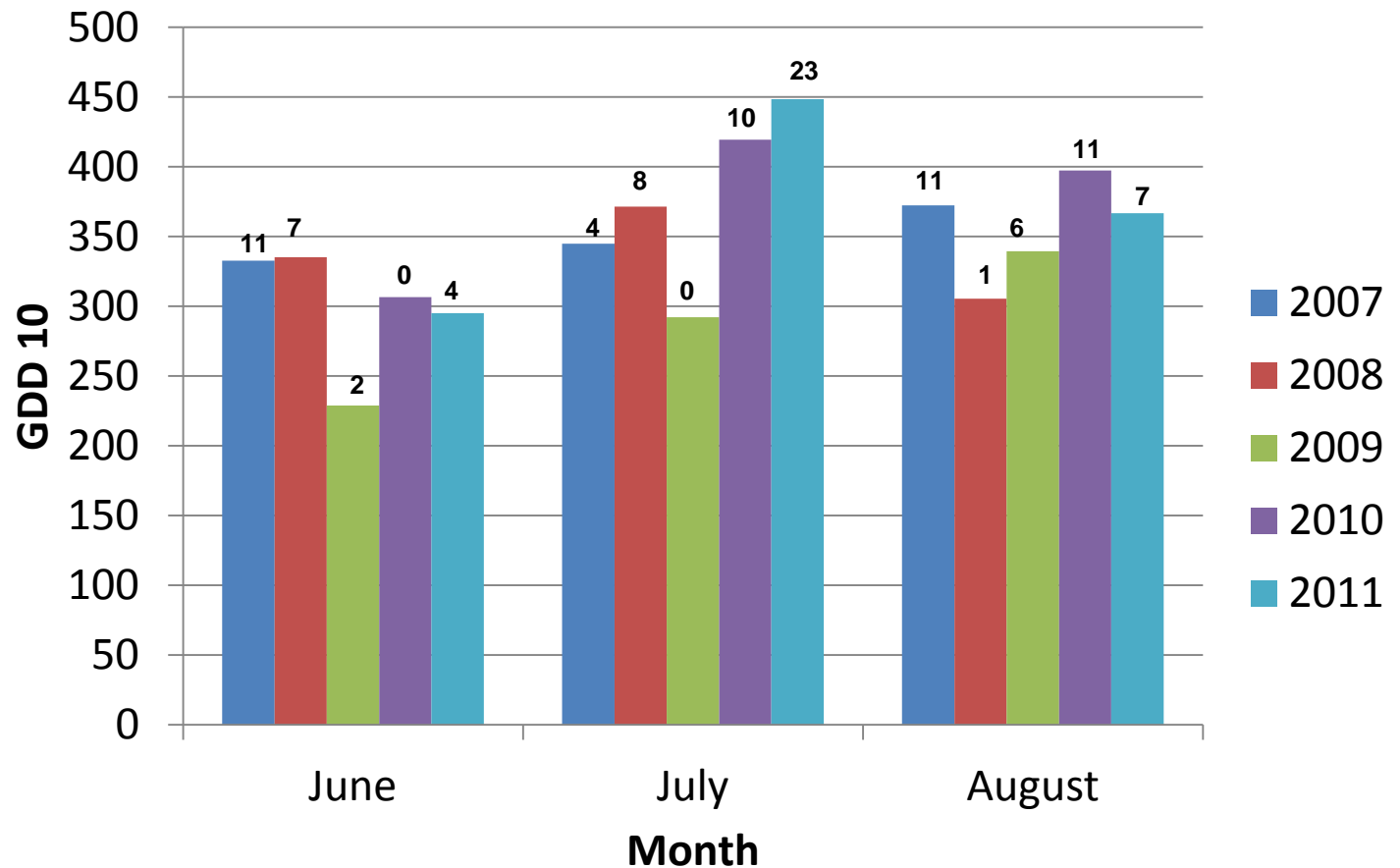


	2007	2008	2009	2010	2011
Fruit Set	June 20	June 28	July 02	June 18	June 29
Veraison	August 19	August 24	August 27	August 15	August 22



Growing Degree Days (10C) - SUMMER

Monthly GDD10 & # of Days > 30°C

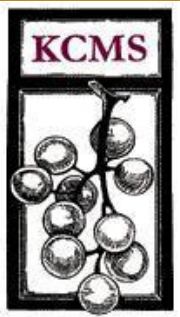




Growing Degree Days (Base 10C) August - October 2007-2011

	August		September		October	
	GDD	#D >30	GDD	#D >20	GDD	#D >20
2007	372.4	11	256.1	25	158.1	14
2008	305.5	1	221.4	23	38.5	6
2009	339.5	6	206.5	23	35.8	1
2010	397.3	11	209.6	20	54.8	7
2011	366.8	7	241.21	21	67.6	7

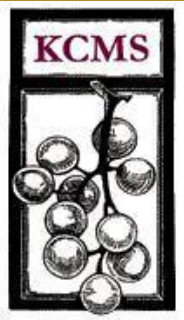
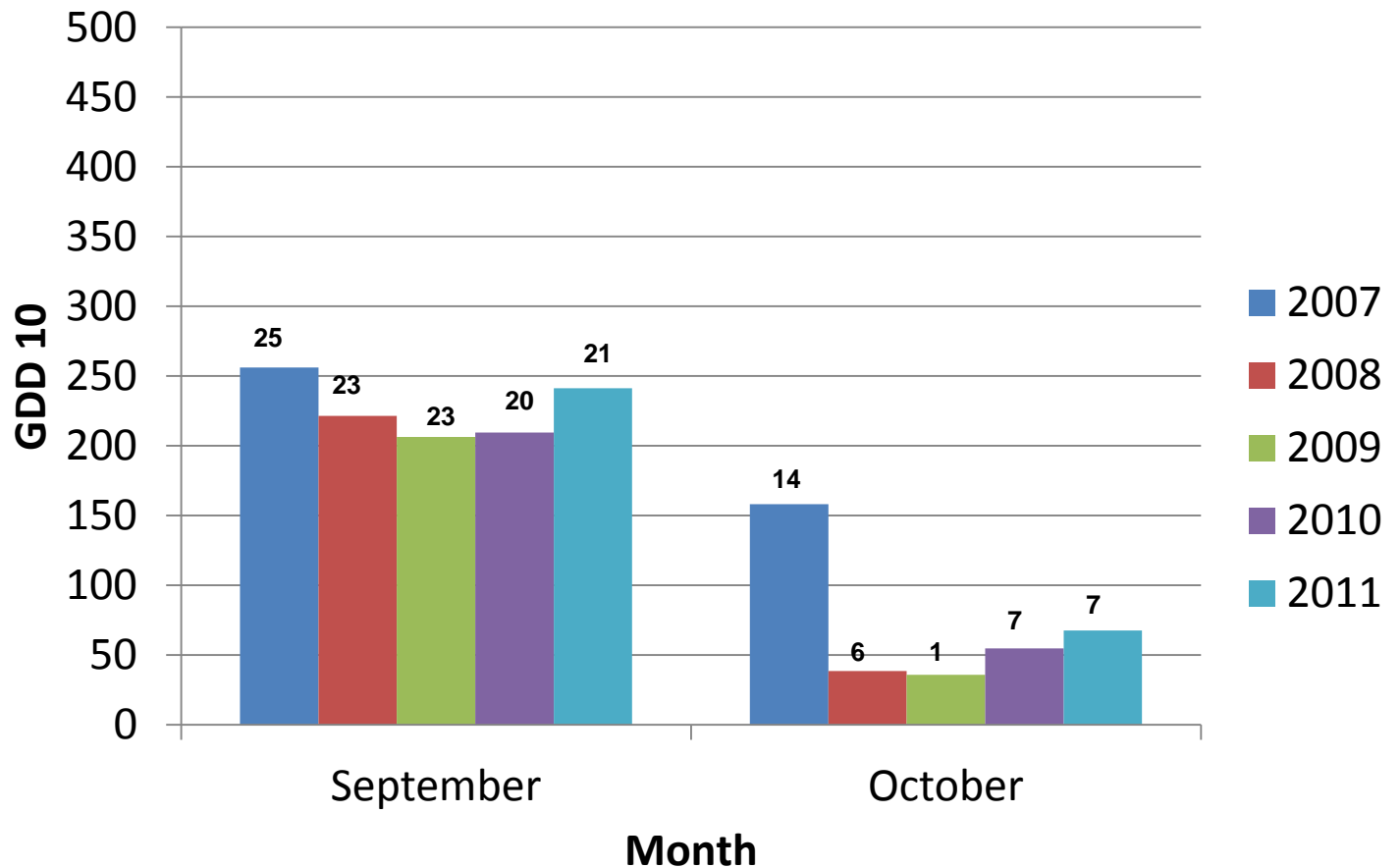
	2007	2008	2009	2010	2011
Veraison	August 19	August 24	August 27	August 15	August 22
Harvest	October 1	October 15	October 19	October 1	October 12
GDD	1647	1426	1266	1662	1589





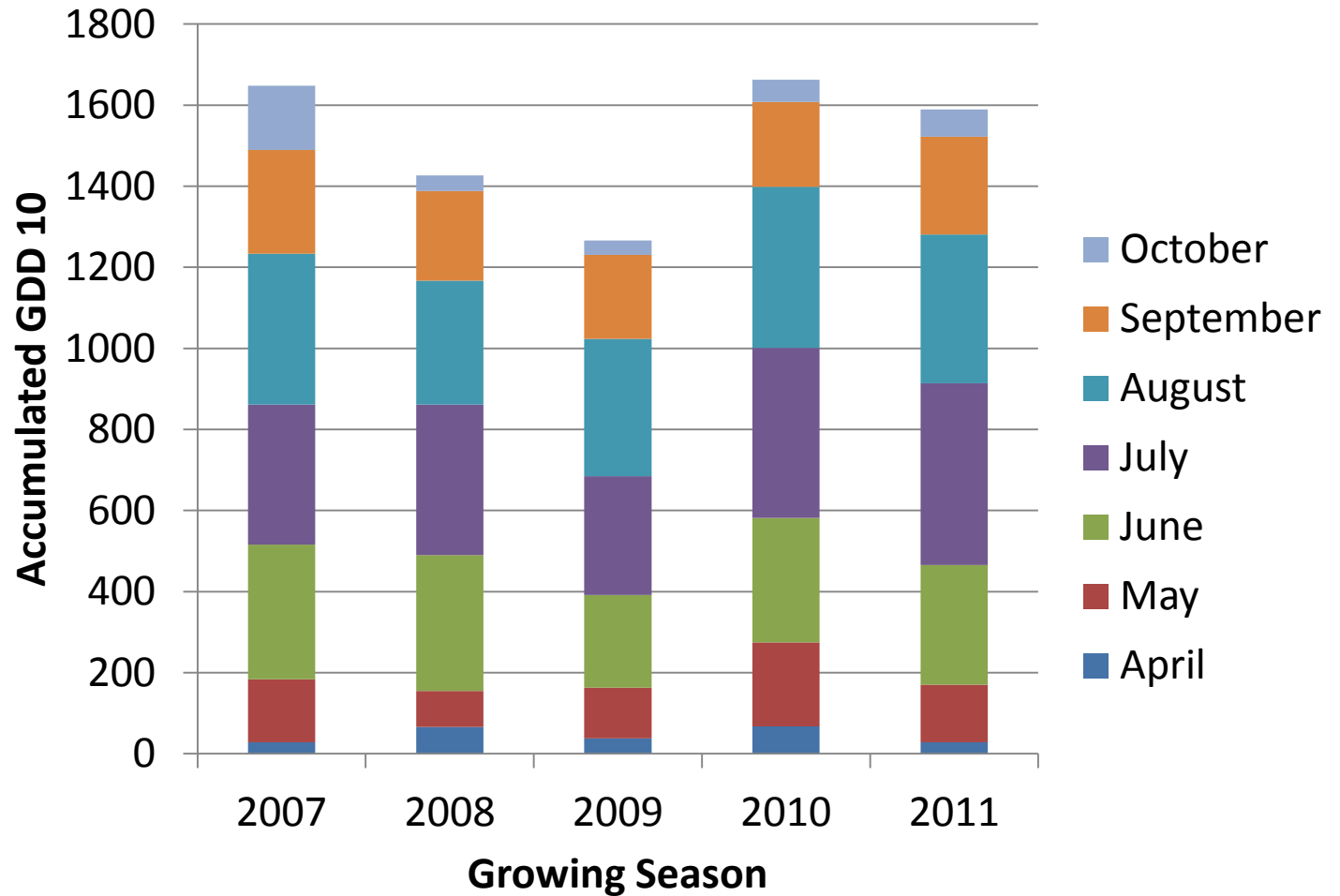
Growing Degree Days (10C) - FALL

Monthly GDD10 & # of Days > 20°C





Monthly Growing Degree Days (10C) Accumulation





2007 - “Dry Year / Hot Harvest”

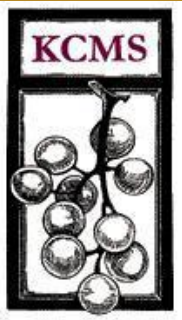
- Cool/wet April followed by warm and dry May
- Relatively normal summer temperatures with lower than normal rainfall experienced
- Dry September followed by very warm October

2008 - “Dry Bloom / Wet Harvest”

- Typical spring temperatures and rainfall
- Dry June/July with relatively normal temperatures followed by a cooler August
- Very wet September and typical October weather

2009 - “Cool All Season - Late Long Year ”

- Wet and cool April followed by a relatively typical May
- Wet and cool June, July and August
- Dry September however temperatures remain cool throughout the fall



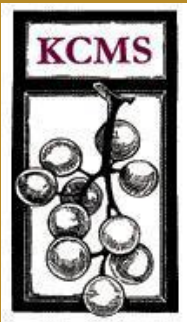


2010 - “Early Start & Early Finish”

- Relatively normal precipitation in April and May with higher than normal temperatures, EARLY START.
- Very wet and cool June however July and August dried out and warmed up
- Typical fall precipitation and temperatures

2011 - “Wet Spring, Dry July & Wet Fall”

- Extremely wet April & May with relatively normal spring temperatures experienced
- Slightly greater than average rainfall in June and August along with normal temperatures however, July was very hot and dry
- September and October were wet with a high frequency of rain events however temperatures were slightly above average

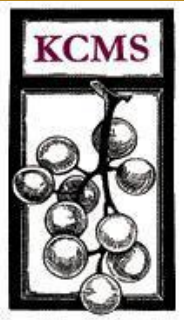


	Bud Break to Prebloom	Bloom to Fruit set	Fruit Set to Veraison	Veraison to harvest
2007	Dry, average Cold start	Dry Hot	Dry Average Temp	Dry Sept Warmer than Average
2008	Dry, average Cool and slow	Dry Warm	Average rain Average Temp	Wet Sept Average Oct Average Temp
2009	Wet Cool Slow	Wet Average temp	Wet to Very Wet Cool	Dry Sept Average Oct Cold October
2010	Dry, average Warm to bloom	Very wet Average temp	Moderate rain Warm	Average Sept and Oct Average temp
2011	Very wet Cold start	Dry Average Temp	Very dry (40 days) Very Hot July	Very wet Sept and Oct Average Temps



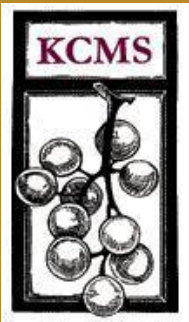
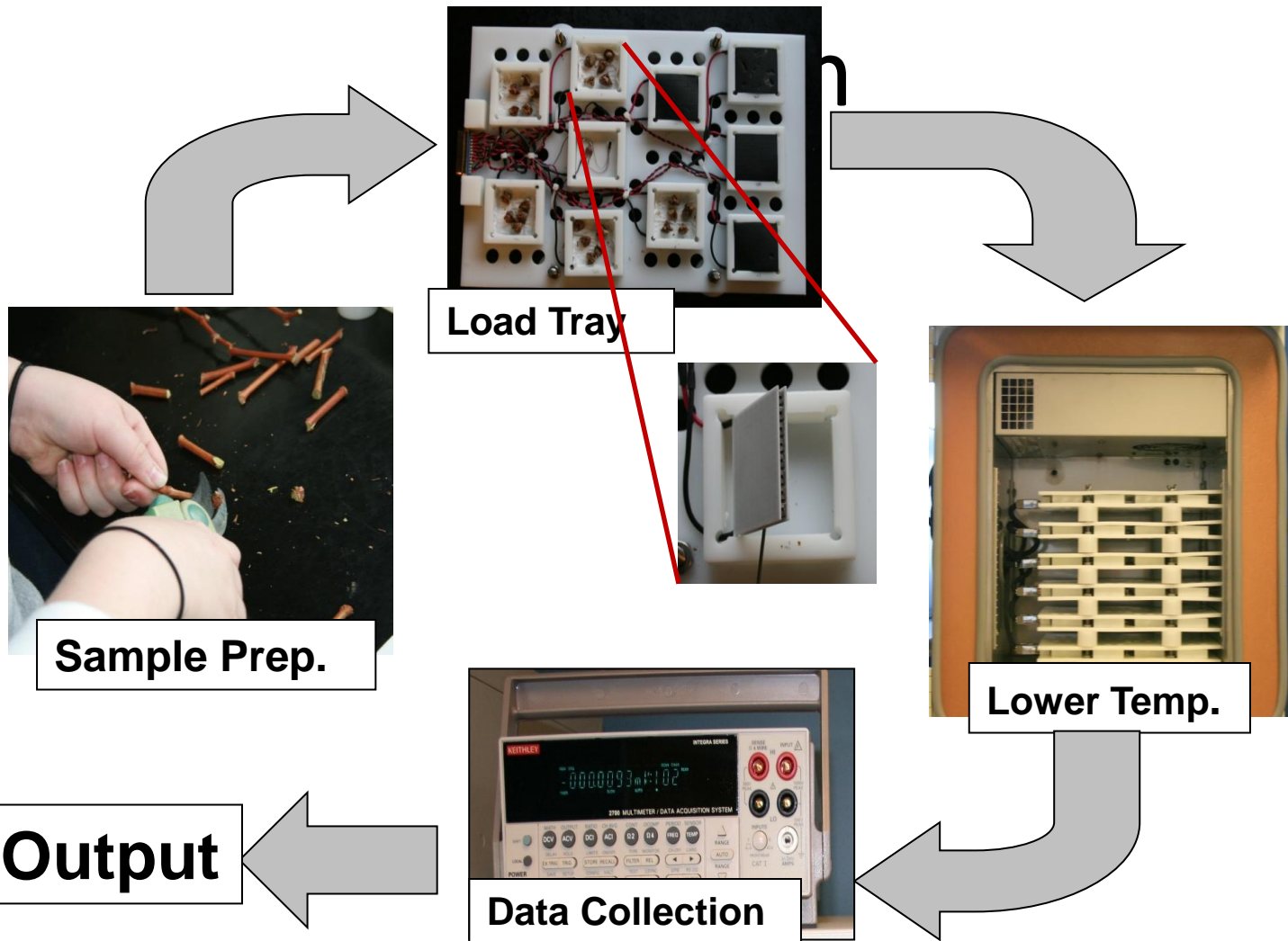
What we are doing?

- **Cold hardiness measured throughout dormant period**
 - Differential Thermal Analysis (DTA) using programmable freezers
- **Comparative bud hardiness levels presented through VineAlert**





Tenney DTA

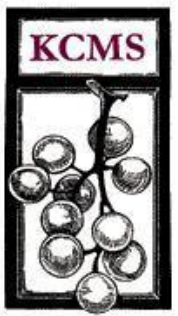
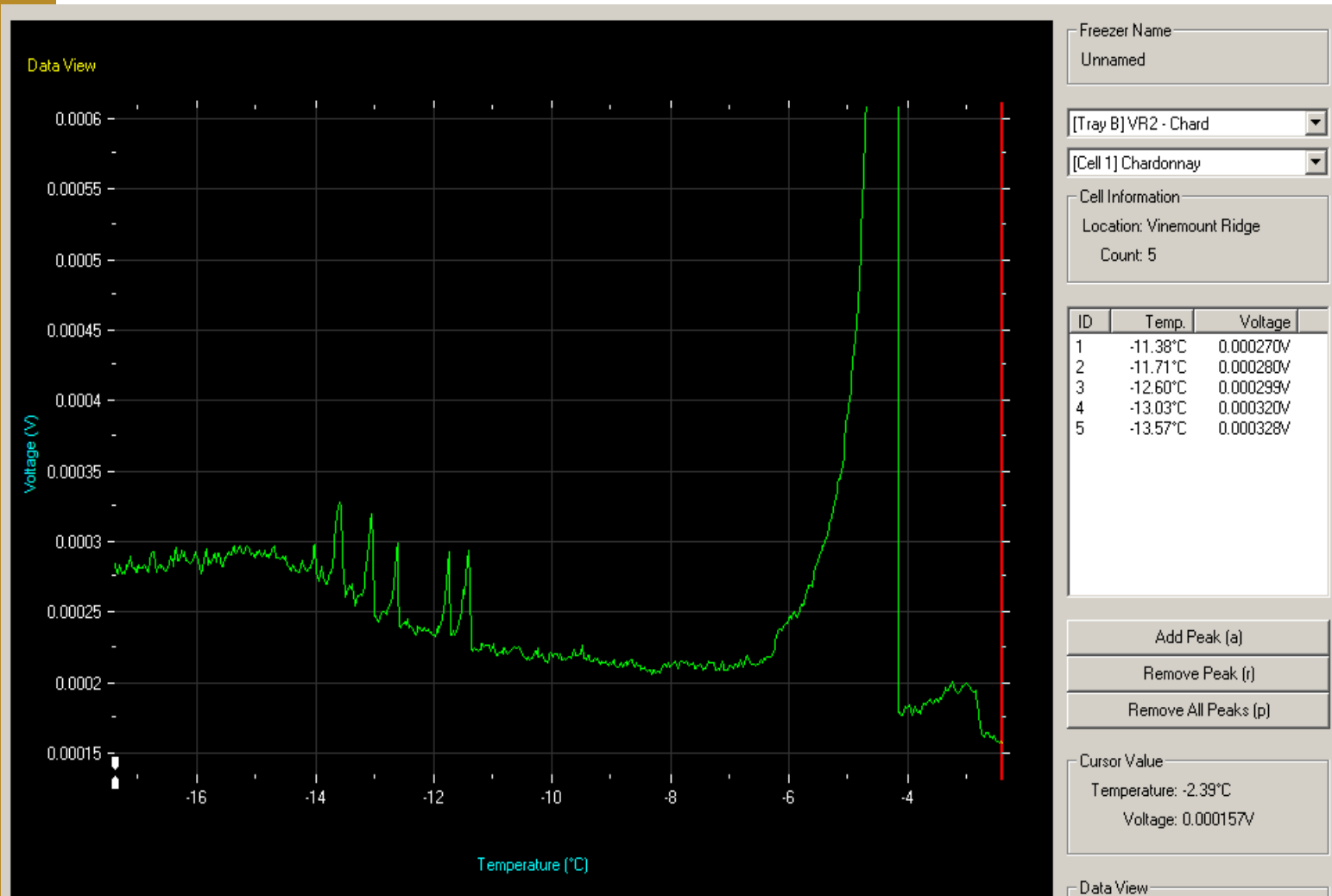




Cool
Climate
Oenology &
Viticulture
Institute

Brock University

Output Data October 11, 2011 (cv. Chardonnay)



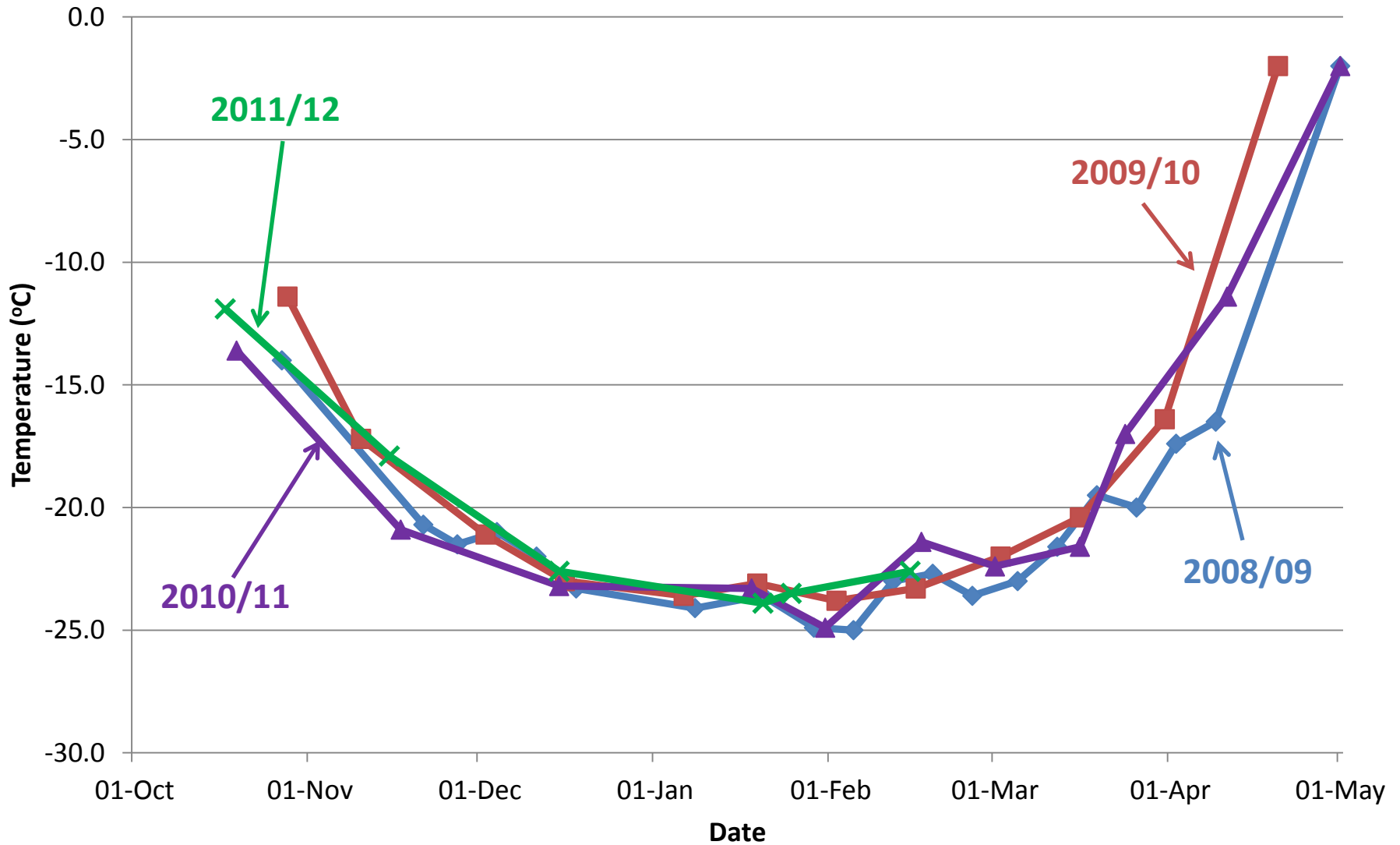
Chardonnay

Rates of Acclimation 2008-2011

Date	2008 (Fall) LTE 50 (°C)	2009 (Fall) LTE 50 (°C)	2010 (Fall) LTE 50 (°C)	2011 (Fall) LTE 50 (°C)
October 20	-11.0	-8.5	-15.0	-11.9
November 20	-19.0	-18.0	-21.0	-17.9
December 20	-24.0	-23.5	-23.5	-22.6
January 20 (following year)	-23.6	-23.1	-23.3	-23.9
Oct 20 → Dec 20	-1.5 °C /wk	-1.8 °C /wk	-1.0 °C /wk	-1.3 °C /wk

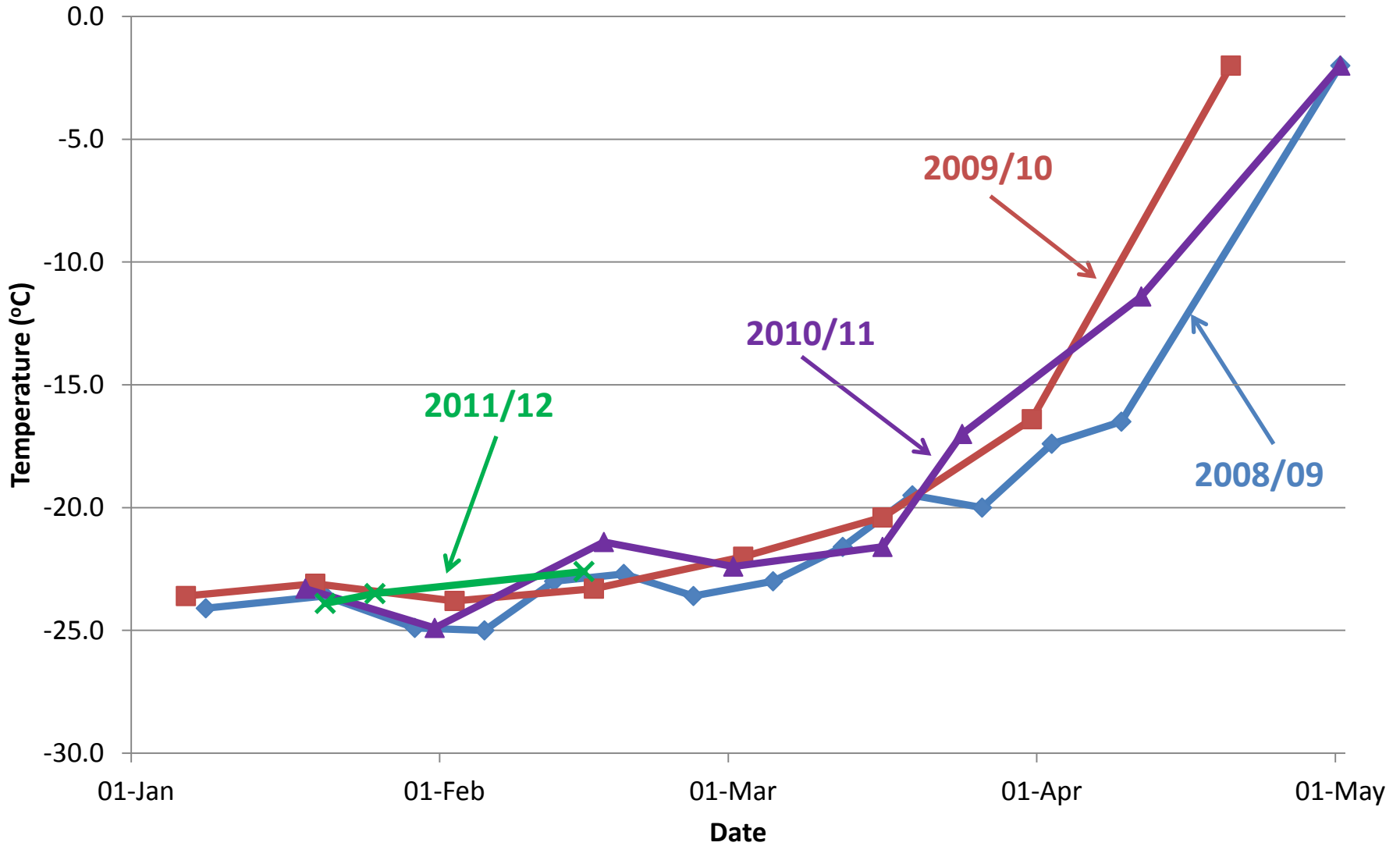
CHARDONNAY

LTE50 Acclimation Curves 2009-2012



CHARDONNAY

LTE50 De-Acclimation Rates (Jan 1 - May 1)



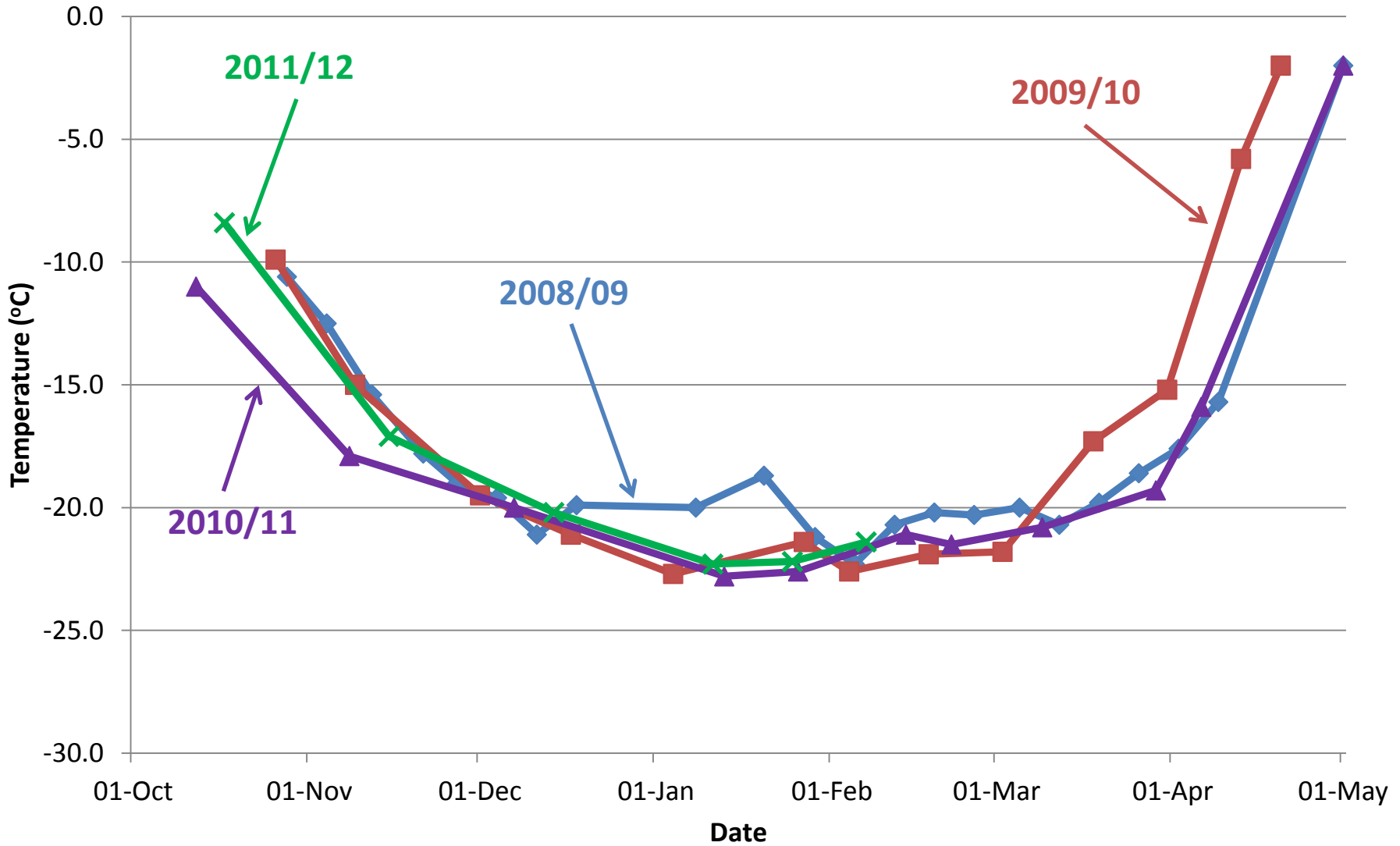
Merlot

Rates of Acclimation 2008-2011

Date	2008 (Fall) LTE 50 (°C)	2009 (Fall) LTE 50 (°C)	2010 (Fall) LTE 50 (°C)	2011 (Fall) LTE 50 (°C)
October 20	-9.0	-10.5	-13.0	-8.4
November 20	-17.0	-19.0	-18.5	-17.1
December 20	-21.0	-23.0	-22.0	-20.2
January 20 (following year)	-21.2	-22.1	-22.8	-22.2
Oct 20 → Dec 20	-1.4 °C /wk	-1.5 °C /wk	-1.1 °C /wk	-1.4 °C /wk

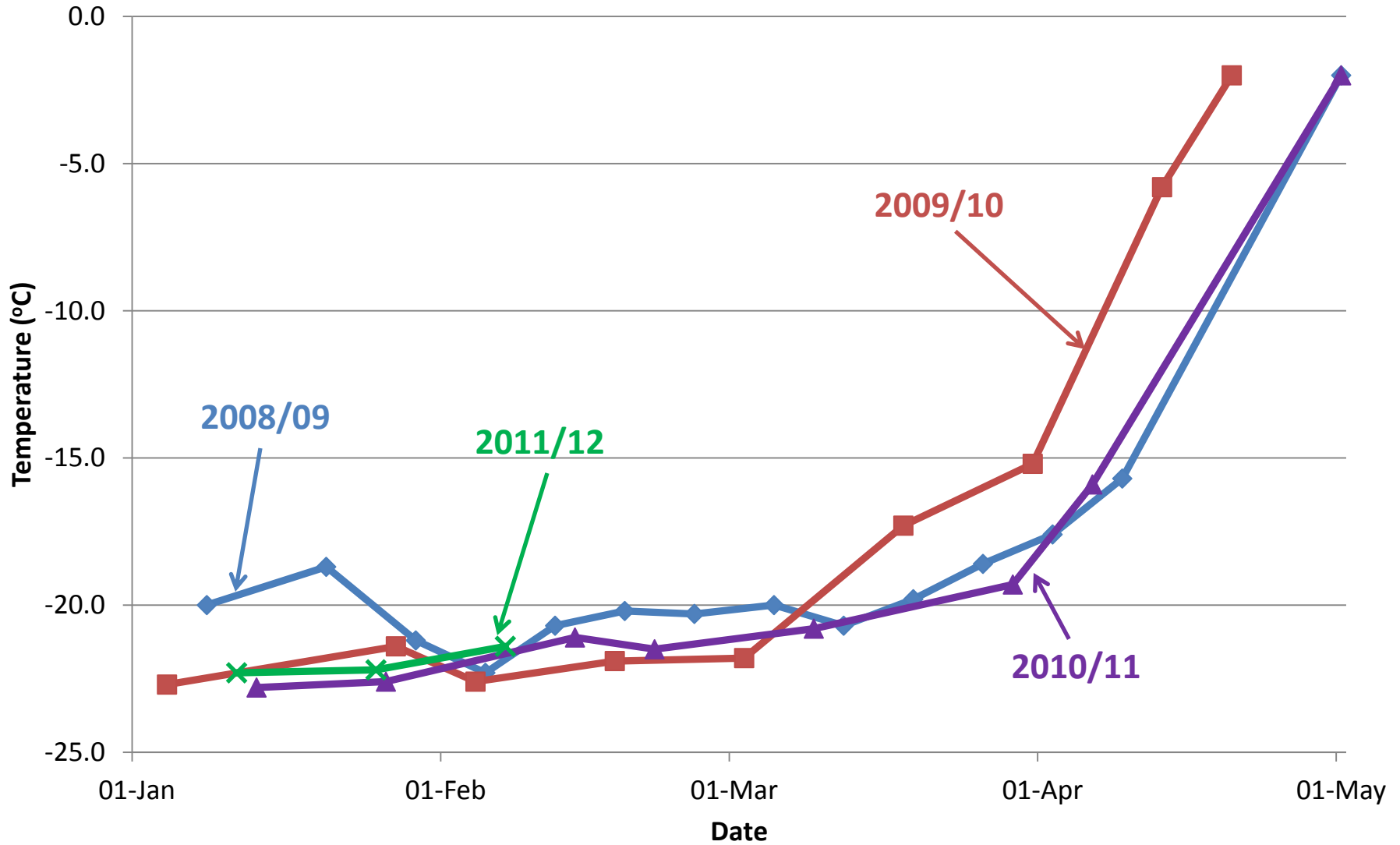
MERLOT

LTE50 Acclimation Curves 2009-2012



MERLOT

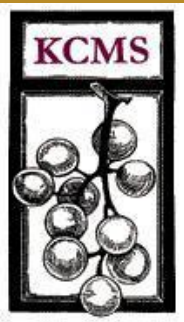
LTE50 De-Acclimation Rates (Jan 1 - May 1)





So What Have We Learned to Date?

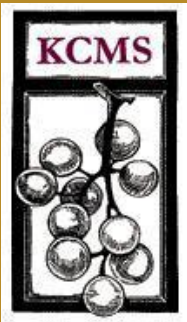
1. Principle of Early to Bed - Early to Rise seems to be occurring. Fast acclimation and fast de-acclimation the next spring
2. Average or low precipitation periods from Veraison to Harvest result in a more rapid rate of acclimation and achievement of maximum hardiness
3. Chardonnay as a consistent level achieved for maximum hardiness regardless of prior season.
However....





So What Have We Learned to Date?

4. De-acclimation begins slowly in late January with a very rapid rate of de-acclimation during March
5. Based on 2011/12 winter data vines have remained extremely hardy despite the “Balmy Winter”
6. Average is for statistics. No two seasons are truly alike though very general values such as GDD may infer similarity
Vine hardiness development is influenced by much more.....





Cool
Climate
Oenology &
Viticulture
Institute

Brock University

Thanks to the following organizations, institutions and government for the financial support and research assistance



Brock University



Grape Growers
of ONTARIO



Agriculture and
Agri-Food Canada

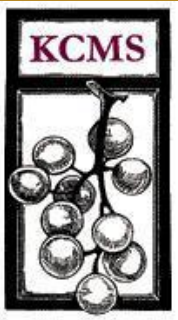
Agriculture et
Agroalimentaire Canada

Ontario

GRAPE & WINE
RESEARCH



Incorporated



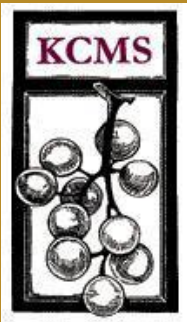


Cool
Climate
Oenology &
Viticulture
Institute

Brock University

Special thanks to the efforts of many !

- Ryan Brewster, Charlene Yungblut, Jim Willwerth and others
- Brock U Electronics
- CCOVI scientists and staff
- Cooperating growers and wineries





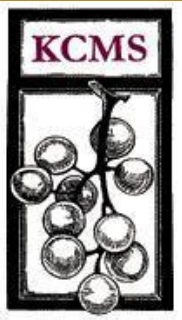
Cool
Climate
Oenology &
Viticulture
Institute

Brock University

How are We Using This Information?

www.ccovi.ca/vine-alert

Up to date information on vine hardiness
in specific areas to allow for best
protection practices to be used





VineAlert: Bud Survival

Vine Alert: Bud Hardiness

Estimating the lowest temperatures grape buds can survive in.

Overview

Recent

Bud Hardiness

Bud Survival

Alerts

Resources

Location:

Niagara Peninsula

Four Mile Creek

Use Map >

Variety:

Merlot

Year:

2011 / 2012

[View Most Recent Data across all Varieties and Locations >](#)

Table

Comparison-Table

Chart

Comparison-Chart

Bud Hardiness Data for Merlot at Four Mile Creek - 2011/2012

Sampling Date	LTE 10 ?	LTE 50 ?	LTE 90 ?
January 4, 2012	-18.4°C	-22.4°C	-24.1°C
December 21, 2011	-16.6°C	-19.4°C	-21.3°C
December 2, 2011	-13.9°C	-17.9°C	-19.9°C
November 8, 2011	-11.7°C	-15.2°C	-16.8°C
October 19, 2011	-6.3°C	-10.3°C	-12.3°C

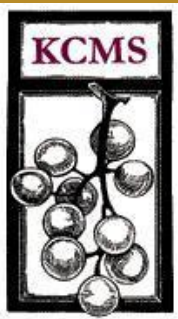
Change to °F

An example of how to read this data:

As of **January 4th**, according to estimates:

- If temperature drops below -18.4°C, 10% of primary buds will die.
- If temperature drops below -22.4°C, 50% of primary buds will die.
- If temperature drops below -24.1°C, 90% of primary buds will die.

NOTE: Your individual situation will vary by numerous factors. Please read the [Resources](#) page for more information.





Vine Alert: Bud Hardiness

Estimating the lowest temperatures grape buds can survive in.

Overview

Recent

Bud Hardiness

Bud Survival

Alerts

Resources

Location:

Niagara Peninsula

Four Mile Creek

Use Map >>

Variety:

All Selected

Year:

2011 / 2012

[View Most Recent Data across all Varieties and Locations >](#)

Table

Comparison-Table

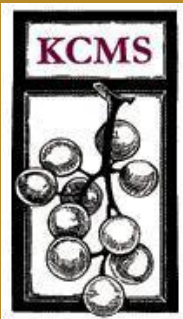
Chart

Comparison-Chart

Viewing **LTE 10** Bud Hardiness Data for **2011/2012**:

Sampling Date	Merlot	Sauv Blanc	Cab Sauv	Cab Franc	Chardonnay
January 4, 2012	-18.4°C				
December 21, 2011	-16.6°C	-18.5°C	-19.3°C		
December 14, 2011				-20.5°C	-21.0°C
December 6, 2011		-17.3°C			
December 2, 2011	-13.9°C				
November 16, 2011		-15.5°C			
November 15, 2011				-15.8°C	-16.6°C
November 8, 2011	-11.7°C				
October 25, 2011		-5.3°C			
October 19, 2011	-6.3°C				
October 17, 2011				-9.9°C	-10.1°C
September 20, 2011		-3.6°C			

Change to °F





Cool
Climate
Oenology &
Viticulture
Institute

Brock University

Vine Alert: Bud Hardiness

Estimating the lowest temperatures grape buds can survive in.

Overview

Recent

Bud Hardiness

Bud Survival

Alerts

Resources

Location:

Niagara Peninsula

Four Mile Creek

Variety:

All Selected

Year:

2011/2012

Use Map »

[View Most Recent Data across all Varieties and Locations »](#)

Table

Comparison-Table

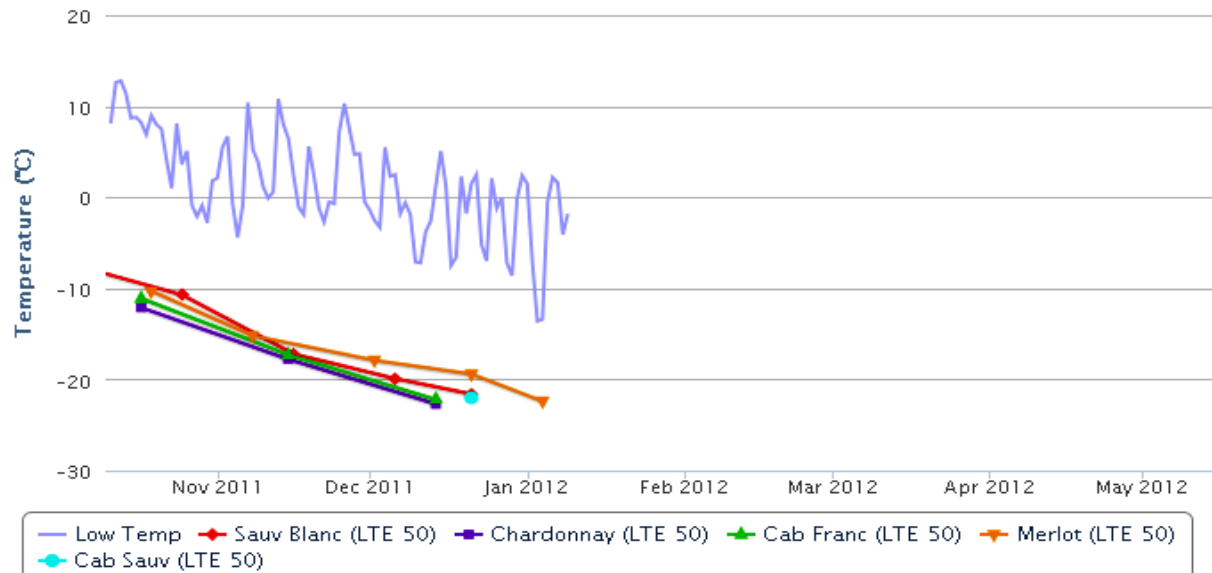
Chart

Comparison-Chart

Compare Varieties

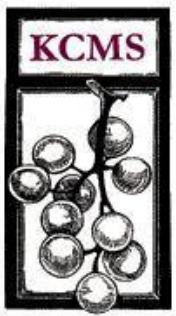
LTE 50

Bud Hardiness Data for All Varieties at Four Mile Creek – 2011/2012



NOTE: Due to the geographic diversity of this region, winter low temperatures can differ considerably at different locations within the same appellation. The weather data displayed is courtesy of Weather Innovations Incorporated - Weather Station in [Notl Virgil](#) - Located nearby Hwy 55 and Concession 6.

Change to °F





Cool
Climate
Oenology &
Viticulture
Institute

Brock University

Thank you! - Any Questions



The New Competitors - but that is for another presentation!

