

2015 BUD SURVIVAL SURVEY IN NIAGARA AREA VINEYARDS

Prepared for:
The Grape Growers of Ontario

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INTRODUCTION

The following report summarizes grapevine bud survival results collected in the Niagara Peninsula throughout March 2015. Samples were collected from eight (8) separate growing areas. Four (4) areas located in the Niagara-on-the Lake growing region and four (4) areas located in the west end of the peninsula. All efforts were made to replicate the same sampling locations and cultivars that were utilized in the 2010-12 and 2014 bud survival surveys conducted by Ker Crop Management Services (KCMS) and submitted to the Grape Growers of Ontario (GGO).

Cold hardiness varies dramatically vineyard to vineyard and cultivar to cultivar due to many environmental, cultural and management variables. Individual, site-specific management records were not available and not outlined within the parameters of the original proposal and this summary report. This includes whether the use of wind machines was an option, 2014 crop load and disease severity for a particular cultivar. Therefore, the intention of this report is not for the development of conclusions explaining specific reasons for bud survival results, nor giving characteristics for those locations with higher bud survival percentages from any of the co-operating vineyard locations.

METHODOLOGY – BUD SURVIVAL ANALYSIS

Grape bud survival was estimated by taking a cross section cut of the compound bud and examining the condition of the primary bud. Not examined are the secondary and tertiary buds, which are much smaller than the primary bud and are typically much less fruitful. We collected 10-12 sample canes, 10-15 buds in length, randomly from each sample block. Only canes with acceptable bud numbers, cane thickness and visibly in good health were selected. Canes that are too thick or too thin, canes with excessive growth or canes with significant tip dieback or obvious disease symptoms were not sampled. Canes for evaluation were selected as those that would best represent the canes that would have remained after pruning is complete.

This method is very commonly used in all grape-growing regions and injury is identified as discolouration (browning or oxidation of injured cells) of bud meristem (growing point) that occurs after critical low temperature exposure. Healthy bud meristems maintain their green colour while injured meristematic tissue have ruptured cells from ice crystal formation and subsequently turn brown due to oxidation. Samples were collected in the field then kept at room temperature (approximately 22 °C) for 24-48 hours to allow the oxidative browning process to take place.

For purposes of this 2015 survey, samples were taken for 11 cultivars (vinifera & hybrid) from each of 8 designated regions in Niagara (Figure 1 & 2). Cultivars examined were; Cabernet Sauvignon, Cabernet Franc, Merlot, Chardonnay, Riesling, Pinot Noir, Pinot Gris, Gewurztraminer, Sauvignon Blanc, Vidal and Baco Noir. Sample canes were collected from March 2 to March 26, 2015.

BUD SAMPLING LOCATIONS

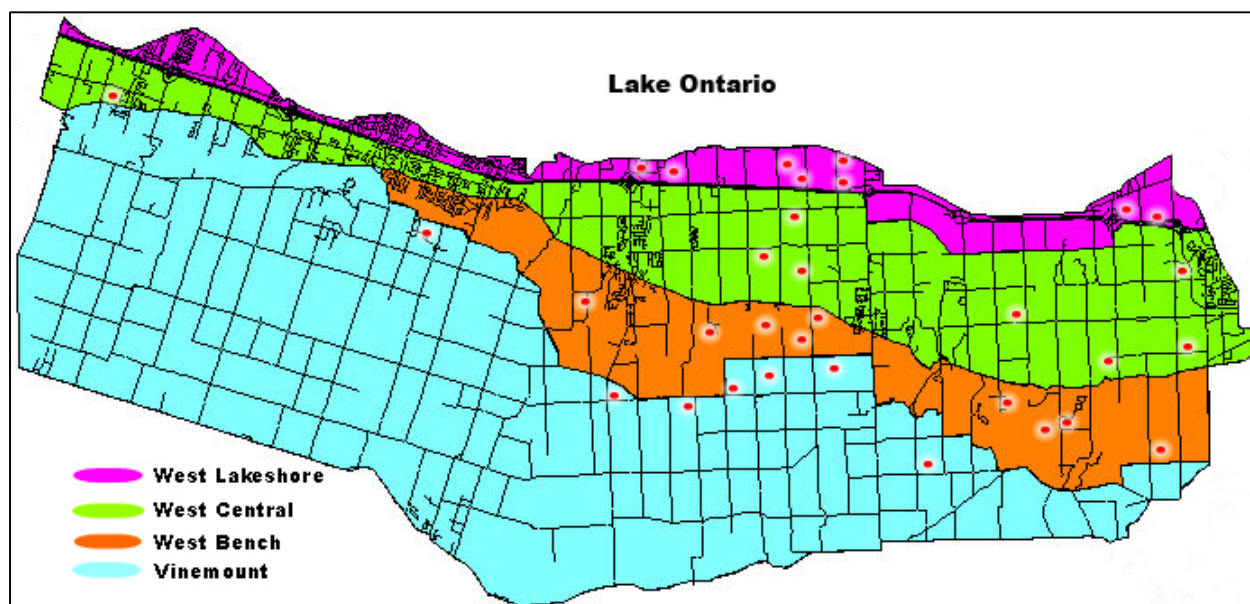


Figure 1. Locations of Niagara area sample vineyards in the 4 sample areas located west of the Welland Canal (St. Catharines, Vineland, Beamsville & Grimsby areas)

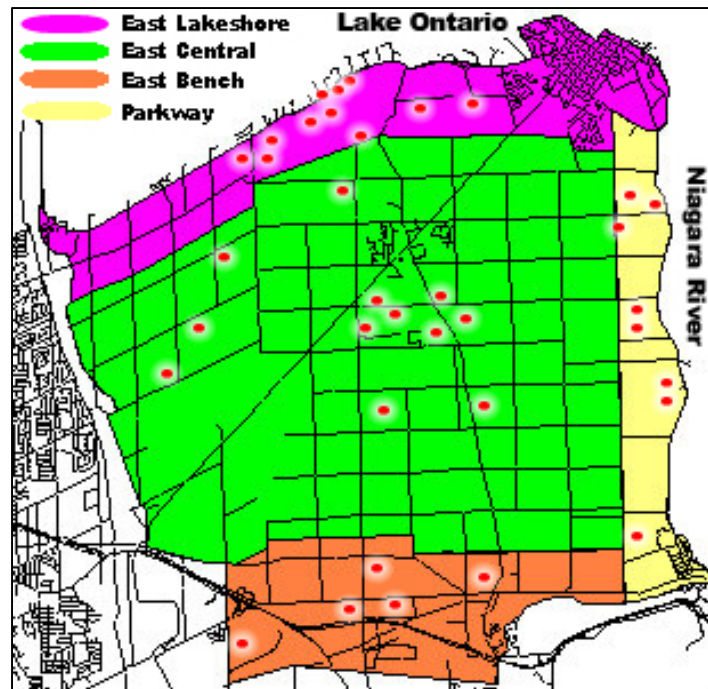


Figure 2. Locations of Niagara area sample vineyards in the 4 sample areas located east of the Welland Canal (Niagara-on-the-Lake, St. David's, Virgil & Queenston areas).

2014/2015 REVIEW OF WEATHER DATA & CRITICAL COLD EVENTS

The winter of 2014/15 has been characterized by lower than average maximum and minimum daily temperatures and greater than normal snowfall accumulations across all of Southern Ontario. At the time of composing this report, there have been a total of six (6) separate cold weather events that could have potentially resulted in some degree of bud damage depending on location and cultivar.

As grapevines were acclimating (October – December 2014), average temperatures consistently remained at or slightly above normal seasonal values. December temperatures were slightly above normal and there were no potentially damaging events recorded. Average temperatures for the month of December were 0.3 °C to 0.7 °C above the 30-year normal. The coldest temperature reached in Niagara was -11 °C at the Grimsby location.

Unlike the above normal December temperatures, Niagara experienced below normal January temperatures. Average January temperatures in 2014 were -6.6 °C in the west end of Niagara and -6.1 °C in the Niagara-on-the-Lake area. Accordingly, the average monthly temperature in the west was 2.5 °C below the daily mean for Vineland, based

on Environment Canada's 30-year averages. One potentially damaging event experienced on January 14th. On this morning, low temperatures in Niagara ranged from - 18.6 °C to - 28.6 °C and an average low temperature of minus 22.4 °C across the Niagara peninsula. During early January 2014, the temperature at which 50% of the buds are likely to die (LTE50) was predicted to be anywhere from - 23.0 °C (cv. Merlot – the most sensitive cultivar) to -23.4 °C (cv. Chardonnay). Due to the temperatures experienced in Niagara, it was estimated, from predictive hardiness evaluations from Vine Alert that from 0-40% of the buds may have been damaged from this event in January depending on location and cultivar.

The colder than normal temperatures experienced in January continued into February 2015. The average monthly temperature in the west end of Niagara was 7.8 °C below normal and the Niagara-on-the-Lake growing area was 7.2 °C below normal. In February, a total of four (4) cold events occurred where some additional bud damage was likely and one (1) event later in the month that was very close to damaging temperatures based on predictive hardiness samples.

During the early morning hours of February 13th, temperatures dropped to a low of - 19.1°C to -23.8°C in the major grape growing regions of Niagara. This would have resulted in some additional bud damage for sensitive cultivars in select growing areas. The coldest temperatures in Niagara were recorded during the February 16 & 17 where low temperatures ranged from -23.6 °C to -29.1 °C in the west end and between -21.8 °C and -25.5 °C in Niagara-on-the-Lake. The last seasonal severe cold event was experienced on February 20 and only the west end growing areas of Niagara experienced temperatures that may have resulted in some additional bud damage. Across the west end of Niagara, temperatures during this event ranged from -23.5 °C to -25.3 °C while the average low temperature across the Niagara-on-the-Lake was only -22.3 °C. A low temperature event was documented on February 24 that was very close to predicted injury temperatures; however, only a small amount of additional bud damage was anticipated.

Both high and low temperatures throughout the beginning of March were below normal with no extreme cold weather events that would have resulted in additional bud injury based on bud hardiness predictive data. Temperatures increased to near normal values through the middle of March and then dropped to slightly below normal values for the end of the month. Low temperatures in March did not come close to temperatures that would reach predicted damage temperatures and no additional bud injury was expected.

Table 1-2 outlines the coldest temperatures recorded by select Weather Innovations (WIN) weather stations located across West Niagara and East Niagara (NOTL).

Table 1. Low temperatures recorded NIAGARA – West

Weather Station	Low Temperatures Recorded (°C) – NIAGARA WEST					
	Jan 14, 2015	Feb 13, 2015	Feb 16, 2015	Feb 17, 2015	Feb 20, 2015	Feb 24, 2015
Grimsby (Vinemount)	-28.6	-32.0	-32.3	-26.8	-27.2	-23.0
Lincoln Fly Rd. (Vinemount)	-19.4	-23.1	-26.8	-20.5	-26.2	-23.6
Beamsville (W. Bench)	-20.5	-21.5	-25.0	-21.5	-24.9	-22.4
Cherry Ave. (W. Central)	-24.3	-21.0	-25.7	-25.4	-23.2	-21.6
St. Cath. Glass Ave. (W. Central)	-24.4	-19.7	-25.0	-26.0	-23.5	-21.9
West St. Cath. (W. Central)	-21.6	-22.4	-25.7	-23.3	-24.9	-21.5
Lincoln Lakeshore (W. Lake)	-22.3	-19.3	-23.6	-22.7	-23.5	-20.8

Source: Weather Innovations Inc. (<http://www.vineandtreefruitinnovations.com/>)

Table 2. Low temperatures recorded NIAGARA - East

Weather Station	Low Temperatures Recorded (°C) – NIAGARA EAST					
	Jan 14, 2015	Feb 13, 2015	Feb 16, 2015	Feb 17, 2015	Feb 20, 2015	Feb 24, 2015
St. David's Bench (E. Bench)	-23.4	-20.6	-22.0	-23.1	-22.9	-22.3
NOTL Parkway (E. Parkway)	-23.1	-19.6	-21.8	-22.2	-22.2	-21.3
NOTL Virgil (E. Central)	-24.0	-20.2	-22.2	-25.5	-22.5	-22.3
NOTL Lakeshore (E. Lake)	-22.4	-19.8	-21.8	-22.8	-22.0	-21.7

Source: Weather Innovations Inc. (<http://www.vineandtreefruitinnovations.com/>)

RESULTS

NOTE – NS indicates that no sample was taken from this cultivar in this area. Areas without a complete data set (3 samples per cultivar) have been reviewed and deemed acceptable as per verbal agreement with GGO staff. Efforts were made to locate sample blocks from these areas by KCMS and GGO staff and were unable to for various reasons. The primary causes were due to insufficient acreage of specific cultivar to secure all 3 separate sampling locations and that cultivar blocks were already pruned to final bud numbers (predominantly the hybrid grape cultivars).

* - Indicates that a Wind Machine covers the sample block. Be aware, this is only an indication that a wind machine is present. No information was collected regarding the usage and management of these machines.

CULTIVAR:	CABERNET SAUVIGNON							
% Primary Bud Survival	LOCATION							
	W. Bench	W. Central	W. Lakeshore	Vinemount	E. Bench	E. Central	E. Lakeshore	Parkway
Sample 1	36*	50	43	35	45	68*	25*	36*
Sample 2	68	43*	N/S	57*	47	22*	27*	17*
Sample 3	39	65	N/S	38	53*	41*	62	34*
2015 Average	48	53	43	43	48	44	38	29
2014 Average	48	50	53	35	58	71	59	72

* – Wind Machine Present

CULTIVAR:	CABERNET FRANC							
% Primary Bud Survival	LOCATION							
	W. Bench	W. Central	W. Lakeshore	Vinemount	E. Bench	E. Central	E. Lakeshore	Parkway
Sample 1	64	43	70	43*	48	55*	46*	32*
Sample 2	36	36	40	37	62*	20*	47*	23*
Sample 3	43*	45*	N/S	41*	58	49*	18	51*
2015 Average	48	41	55	40	56	41	37	35
2014 Average	56	54	46	23	63	55	66	61

* – Wind Machine Present

CULTIVAR:	MERLOT							
% Primary Bud Survival	LOCATION							
	W. Bench	W. Central	W. Lakeshore	Vinemount	E. Bench	E. Central	E. Lakeshore	Parkway
Sample 1	57*	20	37	5	45	50*	57*	50*
Sample 2	26	39*	27	17*	67	21*	57*	54*
Sample 3	30	N/S	N/S	12	67*	40*	52	11*
2015 Average	38	30	32	11	60	37	55	38
2014 Average	31	23	39	15	40	53	53	51

* – Wind Machine Present

CULTIVAR:	PINOT NOIR							
% Primary Bud Survival	LOCATION							
	W. Bench	W. Central	W. Lakeshore	Vinemount	E. Bench	E. Central	E. Lakeshore	Parkway
Sample 1	49	50	59	69*	87	59*	52	22*
Sample 2	53	35*	74	46	70*	64*	44	54*
Sample 3	79	60*	N/S	42	69	45	54	N/S
2015 Average	60	48	67	52	75	56	50	38
2014 Average	52	59	75	34	56	72	68	72

* – Wind Machine Present

CULTIVAR:	CHARDONNAY							
% Primary Bud Survival	LOCATION							
	W. Bench	W. Central	W. Lakeshore	Vinemount	E. Bench	E. Central	E. Lakeshore	Parkway
Sample 1	27*	29	21	24	73	28*	45*	23*
Sample 2	48	30*	68	31	50	40*	20*	58*
Sample 3	32	42	57	13*	59*	46*	16*	54*
2015 Average	36	34	49	23	61	38	27	45
2014 Average	46	56	52	35	67	65	66	73

* – Wind Machine Present

CULTIVAR:	RIESLING							
% Primary Bud Survival	LOCATION							
	W. Bench	W. Central	W. Lakeshore	Vinemount	E. Bench	E. Central	E. Lakeshore	Parkway
Sample 1	55*	37	61	48	75	16	46*	13
Sample 2	62	52*	40	27	60*	34*	26*	56*
Sample 3	44	41	22	45*	64	60*	66	20*
2015 Average	54	43	41	40	66	37	46	30
2014 Average	53	48	63	47	51	70	71	66

* – Wind Machine Present

CULTIVAR:	PINOT GRIS							
% Primary Bud Survival	LOCATION							
	W. Bench	W. Central	W. Lakeshore	Vinemount	E. Bench	E. Central	E. Lakeshore	Parkway
Sample 1	45*	47	74	77*	N/S	57*	26	45*
Sample 2	73	70*	54	N/S	N/S	43*	33	55*
Sample 3	N/S	N/S	N/S	N/S	N/S	77*	26	N/S
2015 Average	59	59	64	77	-	59	28	50
2014 Average	49	42	58	45	-	74	69	67

* – Wind Machine Present

CULTIVAR:	GEWURZTRAMINER							
% Primary Bud Survival	LOCATION							
	W. Bench	W. Central	W. Lakeshore	Vinemount	E. Bench	E. Central	E. Lakeshore	Parkway
Sample 1	32*	29	41	N/S	57*	58*	23	38*
Sample 2	28	28*	31	N/S	N/S	35	47	19*
Sample 3	49	N/S	N/S	N/S	N/S	N/S	42	N/S
2015 Average	36	29	36	-	57	47	37	29
2014 Average	41	25	37	36	29	44	62	50

* – Wind Machine Present

CULTIVAR:	SAUVIGNON BLANC							
% Primary Bud Survival	LOCATION							
	W. Bench	W. Central	W. Lakeshore	Vinemount	E. Bench	E. Central	E. Lakeshore	Parkway
Sample 1	45*	42*	57	7	55*	48*	36*	23
Sample 2	33	35	36	51	N/S	57*	10*	42*
Sample 3	27	N/S	53	N/S	N/S	52*	12*	16*
2015 Average	35	39	49	29	55	52	19	27
2014 Average	29	58	36	36	45	57	56	36

* – Wind Machine Present

CULTIVAR:	VIDAL							
% Primary Bud Survival	LOCATION							
	W. Bench	W. Central	W. Lakeshore	Vinemount	E. Bench	E. Central	E. Lakeshore	Parkway
Sample 1	40	56	40	73	70	28*	12	62
Sample 2	N/S	55	88	34	76	70	64	61
Sample 3	N/S	66	84	45	61	61	N/S	50
2015 Average	40	59	71	51	64	53	38	58
2014 Average	78	69	68	55	78	53	77	69

* – Wind Machine Present

CULTIVAR:	BACO NOIR							
% Primary Bud Survival	LOCATION							
	W. Bench	W. Central	W. Lakeshore	Vinemount	E. Bench	E. Central	E. Lakeshore	Parkway
Sample 1	N/S	50	N/S	85	90	85	N/S	N/S
Sample 2	N/S	89	N/S	82	N/S	88	N/S	N/S
Sample 3	N/S	80	N/S	70	N/S	N/S	N/S	N/S
2015 Average	-	73	-	79	90	87	-	-
2014 Average	-	79	-	73	88	75	-	80

* – Wind Machine Present

The authors would like to express their appreciation to all grower co-operators that allowed us on-site for samples to be collected and included in this survey. All data presented is reflective of samples taken up to March 27, 2015.

CULTIVAR SUMMARY

The following are brief comments about the results from each cultivar.

Cabernet Sauvignon

Primary bud survival ranged from 17% (East Parkway) - 68% (East Central & West Bench)

Cabernet Franc

Primary bud survival ranged from 18% (East Lakeshore) - 70% (West Lakeshore)

Merlot

Primary bud survival ranged from 5% (West Vinemount) - 67% (East Bench)

Pinot Noir

Primary bud survival ranged from 22% (East Parkway) - 87% (East Bench)

Chardonnay

Primary bud survival ranged from 13% (West Vinemount) - 68% (West Lakeshore)

Riesling

Primary bud survival ranged from 13% (East Parkway) - 75% (East Bench)

Pinot Gris

Primary bud survival ranged from 26% (East Lakeshore) - 77% (East Central & West Vinemount). Note that there were fewer locations sampled, as this cultivar is not as widely distributed in Niagara as other cultivars.

Gewurztraminer

Primary bud survival ranged from 19% (East Parkway) - 58% (East Central)

Sauvignon Blanc

Primary bud survival ranged from 7% (West Vinemount) - 57% (East Central & West Lakeshore)

Vidal

Primary bud survival ranged from 12% (East Lakeshore) - 88% (West Lakeshore)

Baco Noir

Primary bud survival ranged from 50% (West Central) - 90% (East Bench)

GENERAL COMMENTS

There appears to be some bud damage present in all cultivars for all growing areas examined. Many of the temperatures outlined in Tables 1-2 were recorded as being very close or were lower than the predicted LTE 50 values, which is the temperature at which 50% of the buds are expected to be killed (www.ccovi.ca/vine-alert).

When greater than 50% of the buds are damaged by cold weather, the degree of phloem damage (where there may be trunk or cane damage) is unknown. It is highly likely that some level of damage to the vascular tissues may have taken place. Many local vineyards have experienced back-to-back winters where cumulative trunk damage is likely. Younger (less than 4 years of age) grapevine trunks are often able to support growth with low levels of phloem damage; however, older trunks that have experienced repetitive damaging events over a number of dormant seasons, may not be able to support crop loads due to reduced levels of conductive tissue to supply sufficient moisture and nutrients to the growing tissues and mid-season vine collapse is a possibility if there additional stresses (e.g. high temperatures, drought, excessive crop load, etc.). For this reason, all growers should be encouraged to again retain a number of suckers this year to continue re-establishing new trunks for future growing seasons. High snowfall accumulations throughout January and February 2015 appear to have been beneficial in protecting lower buds on trunks and near the graft union.

Vine collapse is the final result of trunk damage where the vascular tissues (mostly phloem) are damaged to a level that can no longer support normal vine function. This usually occurs at a time when the vine is going through a demanding growth stage like bloom or veraison however, this collapse can occur at other growth stages and can be highly influenced by environmental stresses like extreme heat or drought. The 2014 growing season was marked by very few environmental stresses. Temperatures remained moderate throughout the season and rainfall was frequent enough that the vines did not encounter any moisture stress. For that reason, vine collapse was minimal in 2014 even though some trunk damage was likely to have occurred in many established vineyards. Watch carefully throughout the 2015 growing season for vine collapse in blocks with significant bud damage in 2014 and 2015.

Crown gall (*Agrobacterium vitis*) is a bacterial disease of grape that survives systemically in grapevines and initiates infections at wound sites such as those caused by cold weather injuries. Cultivars of *Vitis vinifera* tend to be highly susceptible to crown gall although hybrid and Native American cultivars may also show symptoms of infection. New galls develop in the cambium layer and the enlargement of these galls affects the development of vascular tissue, compromising nutrient flow and vine health. New, small galls were observed at a number of Niagara area vineyard blocks with older trunks last season, and we expect these symptoms to continue enlarging throughout

2015. Growers should be watching closely for evidence of crown gall infections this upcoming growing season as well as the 2016 growing season.

From general observations, there does not appear to be an identifiable difference in bud survival vales between vineyards with wind machines and vineyard with no wind machines. It must be noted we do not have any data from these sites to indicate if or when they were operated and durations of operation of the machines.

During the first damaging cold event experienced on January 14, there were small to moderate inversions present depending on location where wind machines could have had some influence. However, during the next severe cold event experienced on February 13th, there were no significant inversions present across Niagara (based on WIN data) and wind machines were not likely to be effective in influencing low temperatures.

Limited inversions (approximately 3 °C difference at 10 meters) were present across the west end of the peninsula during the next cold event on February 16 and no effective inversions were identified in Niagara-on-the-Lake during this event. The strongest cold event temperature inversions were recorded during the February 17 episode where a range of 2 – 6.5 °C inversions were recorded across Niagara. The last cold episode (February 20), no inversions were identified and ironically there were negative inversions (where ground temperatures were higher than those at 20 M) recorded in multiple locations across Niagara-on-the-Lake. Sample blocks that have wind machines present are indicated with an asterisk (*) in the results section of this report.

It has been observed from previous bud hardiness and bud survival evaluations that cultivar blocks which have been left for ice wine harvest have had lower maximum hardiness levels (LTE 50 higher than expected) that may be attained and appear to have more bud damage when compared to blocks of the same cultivar harvested at the same site in the fall for table wine. This was observed in both cv. Vidal and cv. Cabernet Franc.