

Overview



- Winter Injury is one of the greatest threats to the success of our industry
- Cold hardiness of grapevines is the main limiting factor for growing grapes in Ontario
- Research focused on cold hardiness identified as a priority by the Industry
- Funding through AAFC Developing Innovative Agri-Products initiative (DIAP), Ontario Ministry of Economic Development and Innovation's (MEDI) Ontario Research Fund (ORF).
- Collaboration between AAFC, MEDI, GGO, CCOVI

Grapevine Cold Hardiness Research

- Vitis vinifera wine grapes are not winter hardy
- Cold hardiness is limiting factor for growing many potential cultivars
- Need to understand important factors for our climate
- Optimization of cold hardiness to deal with cold winters and weather fluctuations during acclimation & deacclimation
 - March 2012!
 - Climate Change

Overall Objectives



- Monitor grapevine cold hardiness and create an advanced web-based database - VineAlert
- Further understand how to maximize grapevine cold hardiness
- Impact of key vineyard management practices and understand the most critical factors involved
- Establish a grapevine cold hardiness 'best practices' guide for our climate

Freeze Injury



- Can occur during acclimation, mid-winter, deacclimation or post bud break
- Likely result in fruit/economic loss, vine injury or vine death
- Also associated costs of removing trunks/vines, renewing vines, replanting etc.

Types

- Direct and easy to see: buds, green tissue
- Indirect or the 'silent' killers: phloem, xylem
 - Trunk injury, shoot collapse during season
 - Crown gall







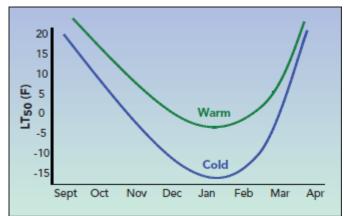




What is Cold Hardiness?



- Ability of plant tissue to survive freezing temperature stresses
- Very complex trait with many contributing factors
- Limited by inherent genetic potential
 - V. riparia 40C; V. vinifera -20's C
- Influenced by environmental conditions
- Highly dynamic condition



(MSU Extension Bulletin E2930, 2007)

Cold Hardiness: Dynamic condition

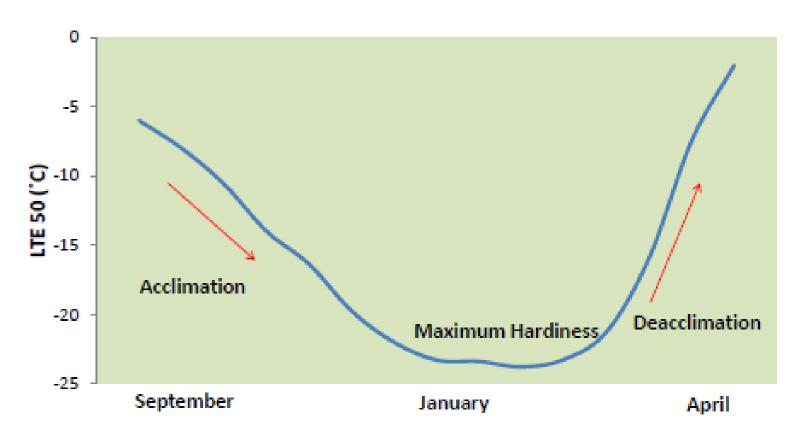


Figure 1. Profile of bud cold hardiness during the dormant season

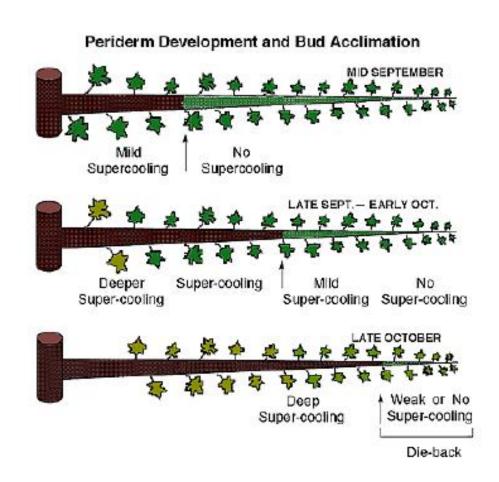
(CCOVI VineAlert Website)

Bud hardiness along cane



October 27, 2010

LTE50(°C)
-13.43
-13.16
-13.51
-12.88
-13.34
-12.59
-12.44
-12.54
-12.12
-11.24



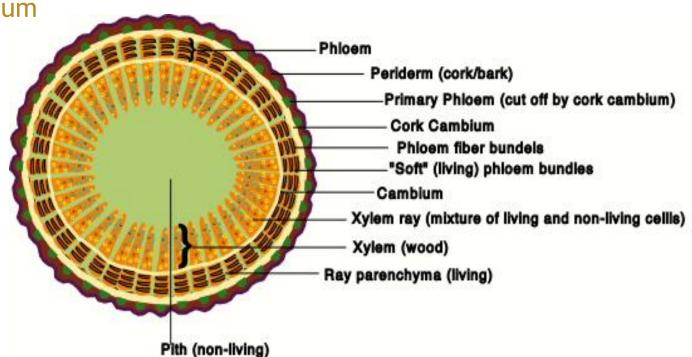
Cold sensitivities of buds and tissues



- Buds and roots
- Phloem
- Older Xylem
- Younger Xylem

Vascular Cambium

Increased hardiness



Courtesy of Cornell University

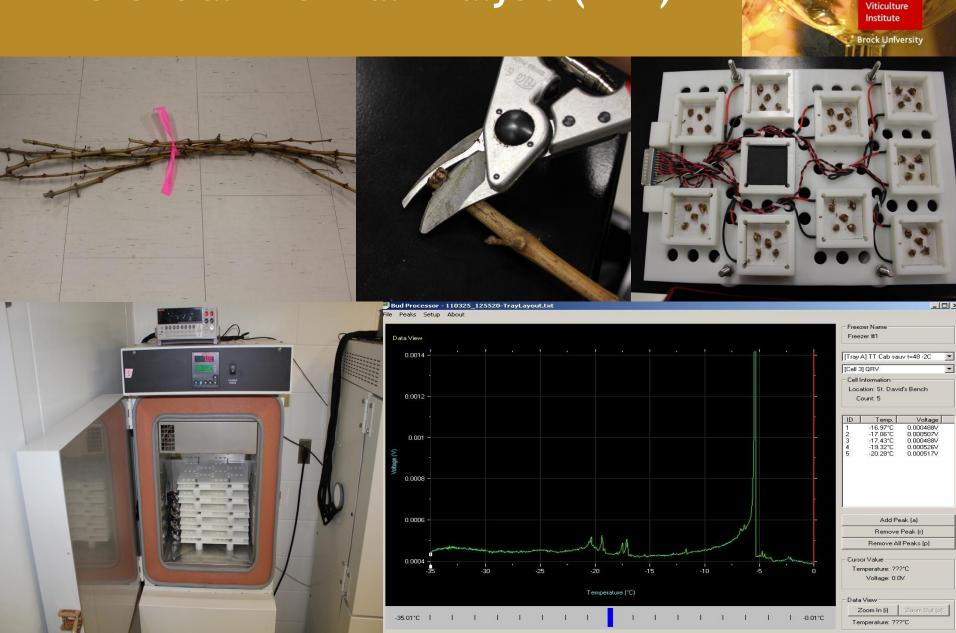
(http://www.nysaes.cornell.edu/hort/faculty/pool/trunkinjury/tihtml/trninjanat.html)

How to test cold hardiness?



- Most common method currently used is Differential Thermal Analysis (DTA)
- First used in 1970's and actually developed in Harrow, Ontario (Harvey Quamme, AAFC)
- Works on the principle of exotherms as water within tissue freezes
- Information used to estimate the temperature at which tissue freezes

Differential Thermal Analysis (DTA)



Climate Oenology &

Current studies concerning cold hardiness



- Regional sampling of bud hardiness across Ontario
- Assessing cold hardiness of different cultivars and locations
- Effects of crop level and harvest date
- Use of geotextile materials as a winter protection method
- Use of plant hormones to optimize cold hardiness
- Yield and vine water status
- Disease

Crop level studies

- Heavy crop load can enhance the probability and severity of cold injury
- High crop levels can lead to poor acclimation and shoot maturation (Edson et al. 1995)
- Crop levels are cultivar and site specific
 - Cluster thinning when warranted can improve hardiness
 - Achieve balance between crop and vigour

Crop Level and Vine Balance







36 shoots/m; one cluster/shoot

16 shoots/m; two clusters/shoot

Photos of Riesling vines, spring 1989, Kelowna, BC (Courtesy of A.G. Reynolds)

Timing of harvest



Factor for late ripening cultivars

- Important in cool climate areas like Ontario
- Later harvest delays cold hardiness?
- Cultivars may perform differently under other climates - matching site to climate
 - Poor maturity probably means less hardiness
 - Early maturity....concept of early to bed, early to rise

Late Harvest and Icewine



- Harvest occurs after leaf fall
- Usually cropped heavier
- Multiple factors at play



- Icewine vines can have lower bud survival
- Do successive years of Icewine production impact vine hardiness or health?

Cold hardiness and wine styles



- Currently investigating the impact of Crop level x harvest date
- 2 cropping levels (full and ½) x different harvest dates (early and late)

Cultivars:

Riesling, Sauvignon blanc, Cabernet franc, Pinot noir, Chardonnay, Merlot (2012)

- Crop levels/timing of harvest is a factor for different wine styles in Ontario
- Early Sparkling
- Normal Table
- Late Late Harvest, Icewine, "Appassimento-style"

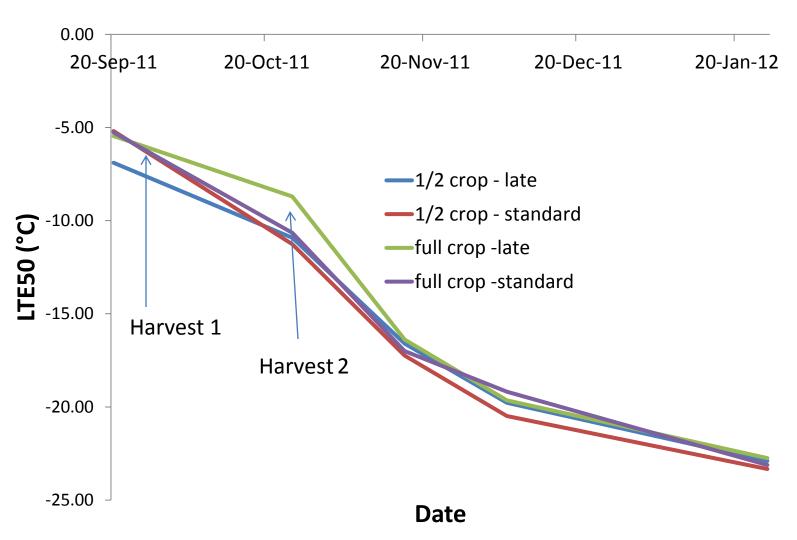
Crop level/harvest date studies Sauvignon blanc - Acclimation -2011



Date	Treatment	LTE10	LTE50	LTE90
	Half crop/late	-4.3	-6.9	-8.4
20-Sep-11	Half crop/standard	-3.9	-5.2	-7.0
	Full crop/late	-4.9	-5.5	-6.1
	Full crop/standard	-3.6	-5.3	-8.5
	Half crop/late	-6.8	-10.9	-12.3
25-Oct-11	Half crop/standard	-9.4	-11.3	-13.0
	Full crop/late	-5.4	-8.7	-9.8
	Full crop/standard	-5.3	-10.7	-11.7
	Half crop/late	-14.9	-16.6	-17.8
16-Nov-11	Half crop/standard	-16.1	-17.2	-18.6
	Full crop/late	-14.7	-16.4	-18.2
	Full crop/standard	-15.1	-17.0	-18.9

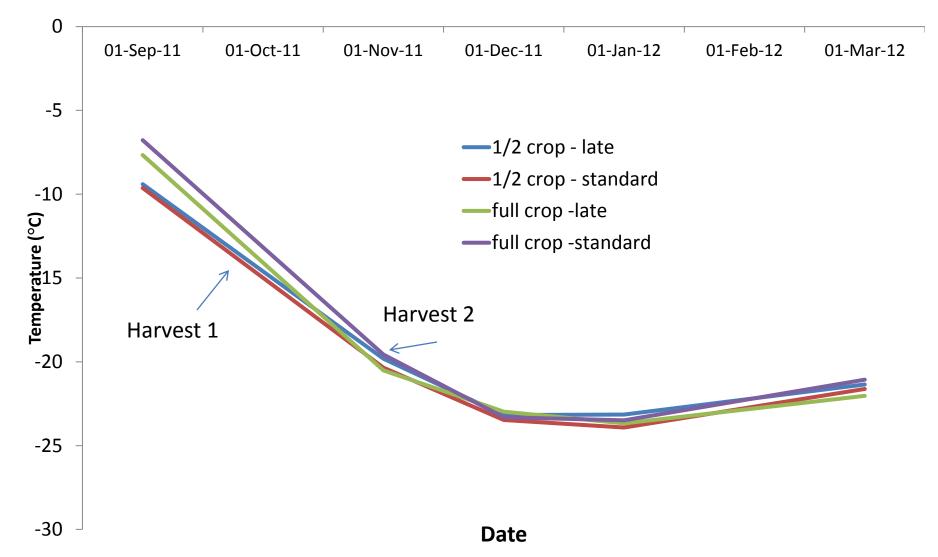
Impact of Crop level and harvest date Sauvignon blanc: Acclimation





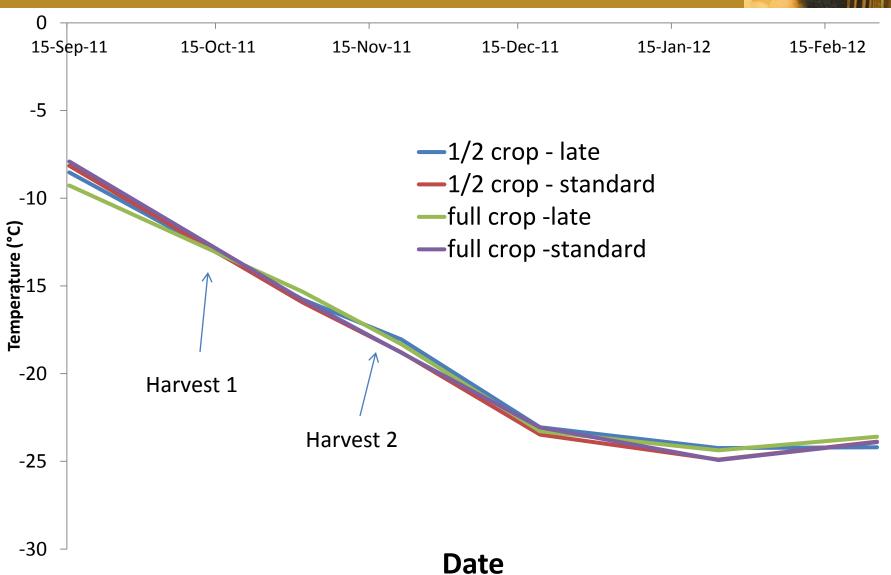
Impact of Crop level and harvest date Pinot noir





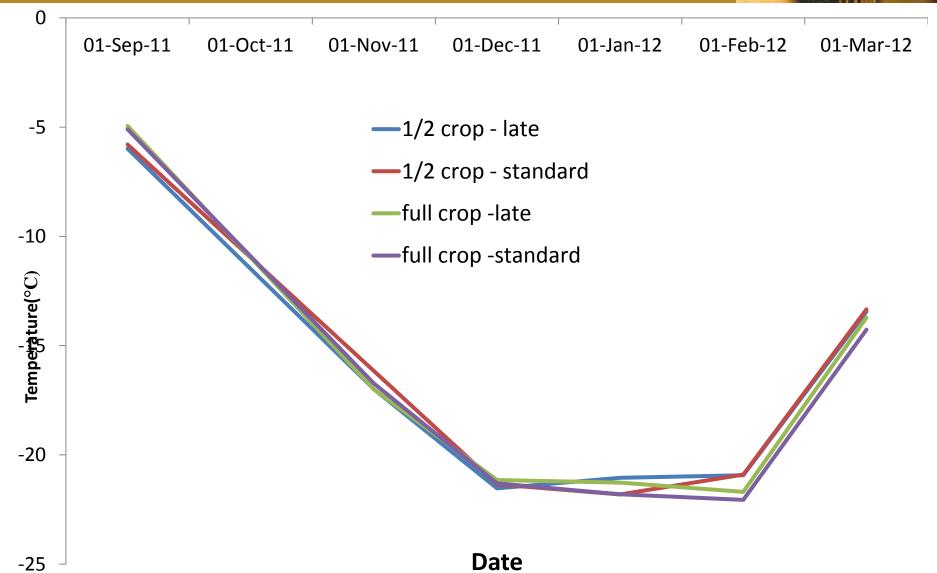
Impact of Crop level and harvest date Riesling





Impact of Crop level and harvest date Cabernet franc





Results to date - 1st year of study



- Crop level appears to have some effects but a greater impact during acclimation than other stages
- Harvest date has less of an impact but an early harvest can lead to some early increases of hardiness during acclimation
- Some influence of early to bed early to rise -
 - Treatments that acclimated earlier or didn't get as hardy appear to be deacclimating first
- Similar to findings from other regions
- Tough vintage for harvest date trials

Ongoing work



- Effects of crop level/harvest date and carbohydrates within tissues using HPLC
 - Relationships between treatments, LTE and CHO associated with cold hardiness (raffinose etc.)
- Vine balance to be examined following pruning to examine optimal crop loads for achieving maximum hardiness for varieties under study
- More statistical analyses to interpret data

Thoughts so far - crop level/harvest date studies



- Varietal responses? Some may be impacted more than others under our climate conditions
- There may be optimal crop levels/crop loads to achieve better hardiness without compromised fruit quality
- Very early harvest vs. very late harvest during a good or poor fall season
- Growing season and vintage differences?
- Later season didn't allow for much time between harvest and leaf fall for C. franc
- Heavier crop levels may have a greater impact

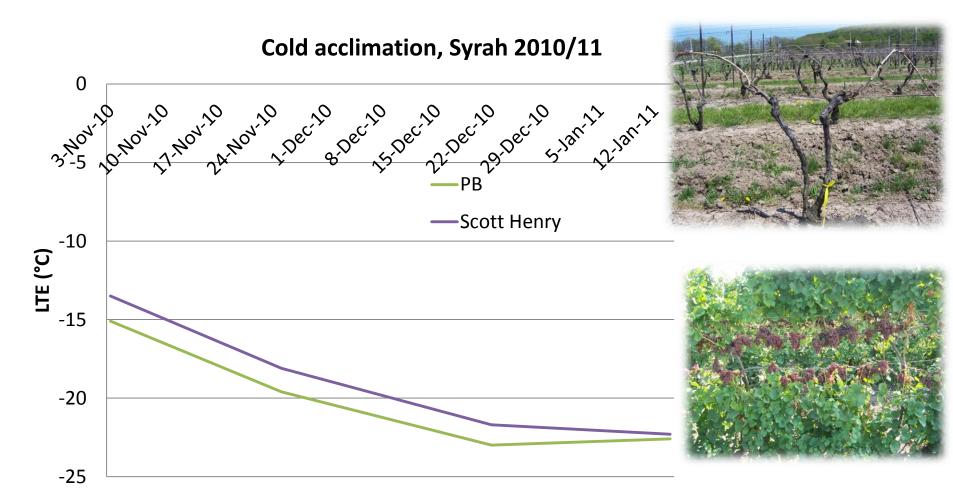
Other cultural practices





Training System

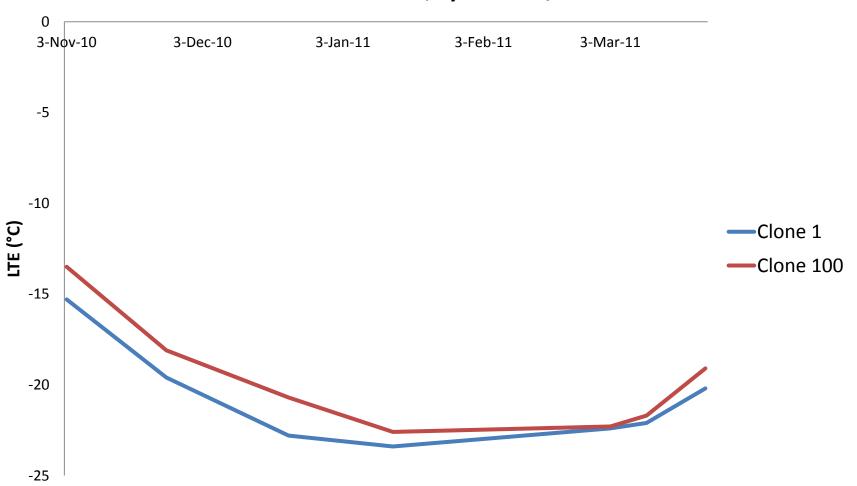




Clones (Syrah, St. David's Bench)



Cold acclimation, Syrah 2010/11



Effect of pruning date on bud hardiness and water content



Table 2. Effect of pruning date on cold hardiness (T₅₀)^z and water content^y of primary buds of Concord grapevines on 30 March 1976.^x

Pruning date 1975-76	Hardiness (T ₅₀ °C)	Water content (g/ g dry weight)
5 Dec.	- 8.9 b	0.91 a
8 Jan. 13 Feb.	− 7.7 b −10.4 a	0.88 ab 0.96 a
29 Feb.	-10.4 a	0.89 a
Unpruned	-10.8 a	0.77 b

Am. J. Enol. Vitic., Vol. 35, No. 4, 1984

(Wolpert and Howell, 1984)

Drainage





General findings of some practices



- Training system has minimal impact on maximum hardiness if managed well (i.e. shoot positioning, thinning)
 - Some systems may however be more susceptible to injury
- Some impact of clones Canadian vines/selections?
- Rootstocks may help vine acclimate sooner but the scion will not be more winter hardy midwinter
- Pruning seems to impact hardiness especially now during deacclimation period
- Poor drainage can impede vine acclimation

Use of Geotextiles for winter protection



- Geotextiles are materials used for winter protection of crops
- Used in Quebec vineyards
- Interest in Ontario vineyards have increased as of late
- Why?
 - Vinifera need protection in some areas
 - Concern about damaging soils
 - Concern about damaging buds
 - Bud rot/loss
 - Timing and weather



Evolution of research



- Determined that there was a need to examine these materials in vineyards further
- Research Questions
 - How effective are these materials at mitigating damaging cold temperatures?
 - Do these materials cause a 'greenhouse effect'?
 - What impact is there on bud hardiness and survival?
- Help determine 'best practices'
- Study in Prince Edward County
 - Sugarbush vineyards with Margaret Appleby (OMAFRA)
 - Geotextile: Hibertex Pro, Dubois Agrinovation



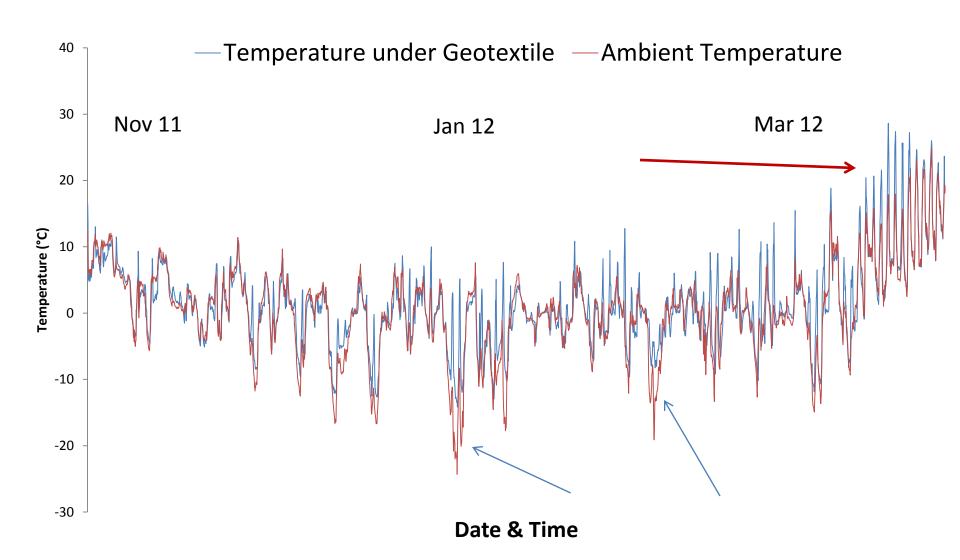
Geotextile experiment



- 8 panels of vines under textile
- Randomized within Chardonnay block
- 2 methods
- Textile above laid down canes on low wire
- Textile tented above spur pruned vine
- Temperature recorded under geotextile and ambient temperature
- Buds sampled for cold hardiness

Impact of Geotextiles on temperature





Impact of geotextiles on bud hardiness



Treatment	Date	LTE10	LTE50	LTE90
	13-Dec-11	-18.7	-22.04	-23.53
Ambient	18-Jan-12	-20.7	-23.4	-25.2
	29-Feb-12	-21.4	-22.64	-23.58
	27-Mar-12	-6.9	-11.1	-13.1
Treatment	Date	LTE10	LTE50	LTE90
	13-Dec-11	-18.63	-21.35	-23.11
Geotextile	18-Jan-12	-16.72	-22.81	-24.52
	29-Feb-12	-20.8	-22.32	-23.57
	27-Mar-12	-6.7	-11.4	-13.5

Preliminary conclusions and thoughts



- Geotextiles do moderate minimum temperature extremes
- Some greenhouse-like effects
- Some impact on bud hardiness (maximum)
- Need more data during deacclimation, bud break, survival
- Timing and removal of application
 - Implications of too early or too late
- Logistics, cost factors and durability
- Continuation and expansion of trials (2012/13)



Summary of fall 2011 to present

- Hardiness was slightly lower during acclimation due to wet fall
- V. mild winter but vines were still quite winter hardy
- We were in great shape at beginning of March with very low risk
- Abnormally high March temperatures have resulted in diminished cold hardiness of all varieties
- 4 weeks ahead of last year so weeks of potential risk and injury

VineAlert http://www.ccovi.ca/vine-alert



Our advanced cold hardiness database



Grapevine Bud Cold Hardiness Database

Overview

Welcome to the Ontario regional grapevine bud cold hardiness webpage. The information contained on this webpage is to provide grape growers with comparative levels of bud hardiness for cultivars at different locations throughout the dormant period. Monitoring bud cold hardiness throughout the dormant period is an invaluable tool to assist grape growers in managing winter injury. The data provided from this database will allow growers and researchers to see how cold-hardy grapevines are within a specific area. Cold hardiness is **not static** but varies throughout the dormant period and is determined through the grapevine's genetic potential and environmental conditions. Therefore, grapevine species and cultivars vary in terms of their cold hardiness. Bud sampling and testing will be done throughout the entire dormant season to monitor cold hardiness through the acclimation, maximum hardiness, and deacclimation periods. This ever-changing bud hardiness data can be helpful in determining when wind machine use or other freeze avoidance methods are warranted to protect the vines from winter injury.

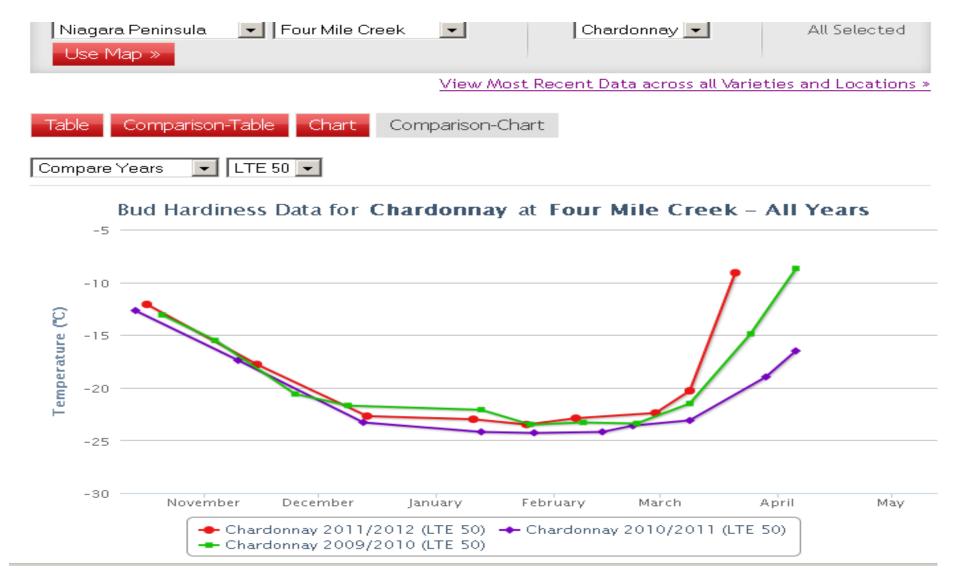
Cold hardiness profile - Chardonnay (Four Mile Creek)



Location: Niagara Peninsula Four Mile Creek		Variety: Chardonnay ▼	Year: 2011/2012 ▼			
Use Map »	<u>View Most</u>	Recent Data across all	Varieties and Locations »			
Table Comparison-Table Chart (Comparison-Cha	rt				
Bud Hardiness Data for Chardonnay at Four Mile Creek - 2011/2012						
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Cold hardiness profile - Chardonnay (Four Mile Creek)



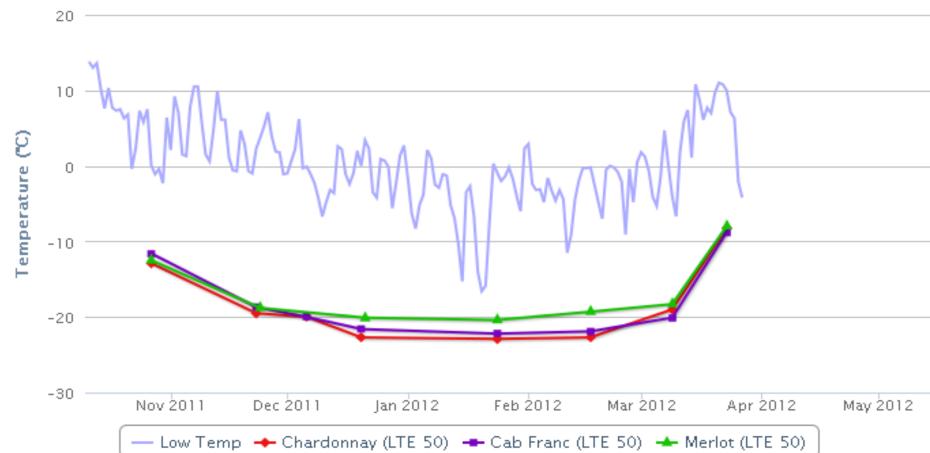


Variety cold hardiness profiles - 2011/12, Colchester, LENS









Conclusions and final thoughts



- Cold Injury is a major threat to the grape and wine industry
- Research to better understand the factors involved and best cultural practices along with
- The ability to provide timely information to the grape grower community through VineAlert will help reduce this continued threat
- Especially true in a year like this one
- The impacts of climate change will likely lead to more extremes and weather fluctuations

Acknowledgments















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- Staff at GGO
- Margaret Appleby (OMAFRA)
- Vineland Research and Innovation Centre John Jansen

Thank you for your attention.



Oenology & Viticulture