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Appassimento Wines: Developing a Signature Style for Ontario

March 27, 2013
CCOVI Lecture Series
Brock University

Climate change and our Industry: What does it mean?

Volatility of weather

- Extreme temperature highs during the growing season – fruit quality, vine survival

Heat stress

- Extreme cold events during the winter that threaten vine survival

Winter injury

- Lack of rain or excessive rain, both compromise vine health, fruit quality

Sour rot from excessive rain

Climate Change: what is the current impact in the grape and wine industry

Erratic weather behaviour within a season and/or drastic season to season variation

- 2003, 2005: winter injury years
  - Cold temperature extremes during the winter months, killed buds and even vines, severe crop shortage of *Vitis vinifera* wine grapes
- 2007: dry, drought year, heat spikes during growing season, fully ripened red varieties, too hot for some aromatic white varieties
  - crop levels reduced, vine stress reduced hardiness for winter months
- 2008/2009: wet cool years, some varieties did not fully ripen
  - vines did not fully harden off in the fall due to extended growth
- 2010: a great vintage year, right balance of rain and sunshine at the right time, no heat or cold spikes to contend with
- 2011: late cool spring, wet fall, lots of disease pressure, warm winter with a few cold spikes
- 2012: early spring, hot/dry summer, long growing season, nice fall vintage- best vintage on record??????

ORF RE Research Program: A proactive approach

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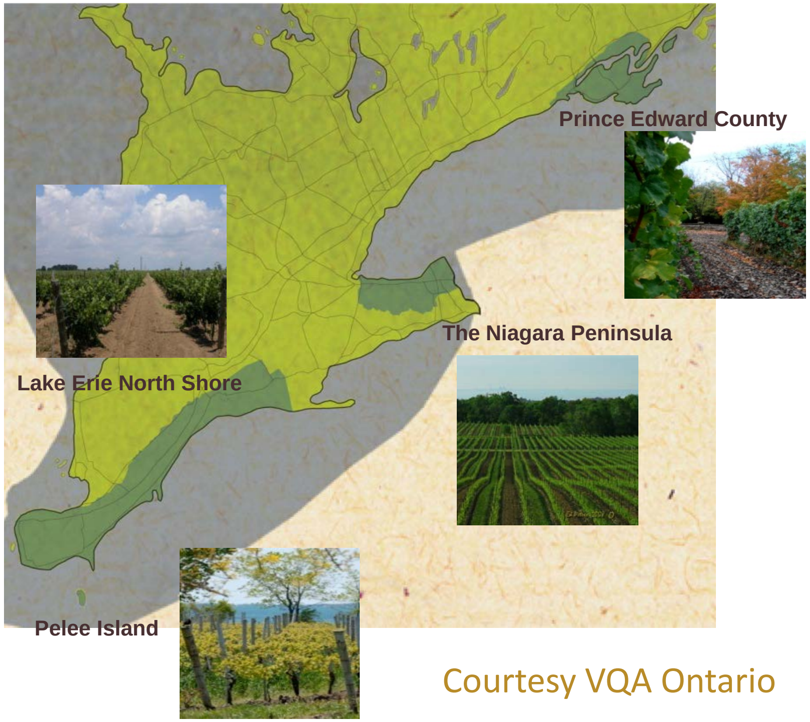
- Proactive approach to mitigate the impact of climate change for our sector by focusing on both viticulture and oenology issues and what climate change will mean for these areas
- allow us to adapt and emerge as an even more vibrant, diversified and sustainable industry



Courtesy VQA Ontario

ORF RE Research Program: A proactive approach

Viticulture and Climate Change

- Impact on wine regions, grapevine cold hardiness

Oenology and Climate Change

- Develop new wine styles for Ontario (appassimento wines, sparkling wines), remediation of wines to remove unwanted flavours resulting from climate change issues

Provincial Funding: Ontario Research Fund Research Excellence Program

Innovation, Integration, Adaptation: A Winning Response to Climate Change for the Ontario Grape and Wine Industry

Partnering Institutions

- CCOVI, NC, UoG, VRIC

Contributing Industry and Government Partners

- GGO, OGWRI, VQAO, 5 wineries, 4 grape growers, greenhouse operation
- Agriculture and Agrifood Canada DIAP program
- $10 million project over 5 years, $2.86 million from province (MEDI: ORF RE program)
- June 2010 – Sept 2015

Oenological Short Term Strategies

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- **Adoption of methods and technologies that mitigate production risks, stabilize wine quality differences year-to-year and contribute to distinctive regional wine styles**
- **How do we take advantage of cool, less optimal years when grapes do not fully ripen**
  - Wine styles that require high acidity - sparkling wine production
  - Ripen fruit post harvest off-the-vine, then ferment into wine (appassimento wines) – unique Ontario style
  - Reduce green characteristics in wine due to under-ripe grapes – methoxypyrazine remediation

Traditional Post-harvest Grape Drying Production Considerations

- Traditional method is a low temperature, long term process
  - 60-100+ days
- Results dependent on
  - air conditions (temperature, relative humidity, air flow)
  - grape characteristics (skin thickness, cuticle waxes, ripeness, surface area/volume ratios) (Paronetto and Dellaglio 2011)
- Concentrate sugars and flavours without increased acidity (Boscaini 2002)
- Varietal characteristics of a grape cultivar strongly influence the resulting wine (Boscaini 2002)
- Biochemical changes in grape are induced by grape responses and microbial responses (Barbanti *et al*, 2008, Thibon *et al*, 2009; Constantini *et al*, 2009).

The Potential Role for Appassimento-type Red Wine Production in Niagara

- Proven production outcomes for the method, relevance to Niagara:
  - Increases sugars, reduces acids, evolves flavours
  - Physically removes grapes from late-season weather risks (precipitation, fog, wind, etc.) and wildlife
- Proven market impact outcomes for the method, relevance to Niagara:
  - Industry growth (Amarone: 1.5 million bottles to 12.5 million in 12 years) (Shah, 2012),
  - Transformation of regional production profiles from low-priced to premium-priced wines (i.e., Amarone della Valpolicella and Ripasso)

	Non-appassimento		***Appassimento***		***Total***
2007:	36.0m	+	15.0m	=	51.0m
2010:	24.0m	+	31.5m	=	55.5m

The Project: Assist industry in developing appassimento wines

Cabernet franc: 5 drying regimes compared

On-vine

Drying chamber

Kiln

Barn

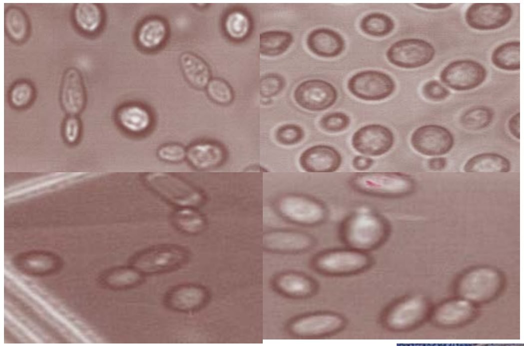
Greenhouse

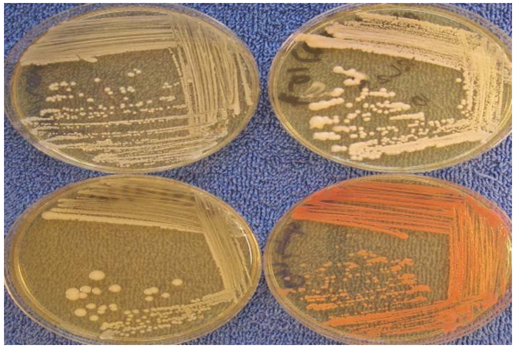
The Project: Assist industry in developing appassimento wines

- **Elucidate for each method the environmental conditions present during the different stages of drying to enhance the understanding of the method and the potential impact of climate-related risks**
- **Currently into Year 3 of study**
  - Cabernet franc grapes, comparing drying regimes

The Project: Assist industry in developing appassimento wines

- Analyze the biochemical and microbial population changes on grape varieties for different drying regimes throughout the drying process
- Analyze the must from the dried fruit and resultant wines
  - Chemical analysis
  - Sensory analysis



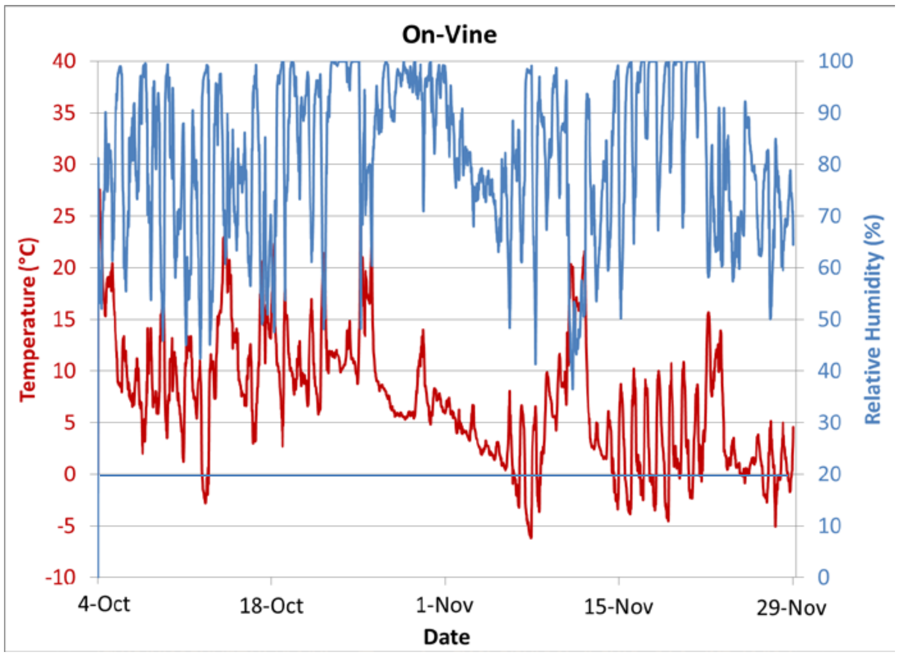


Materials/Methods

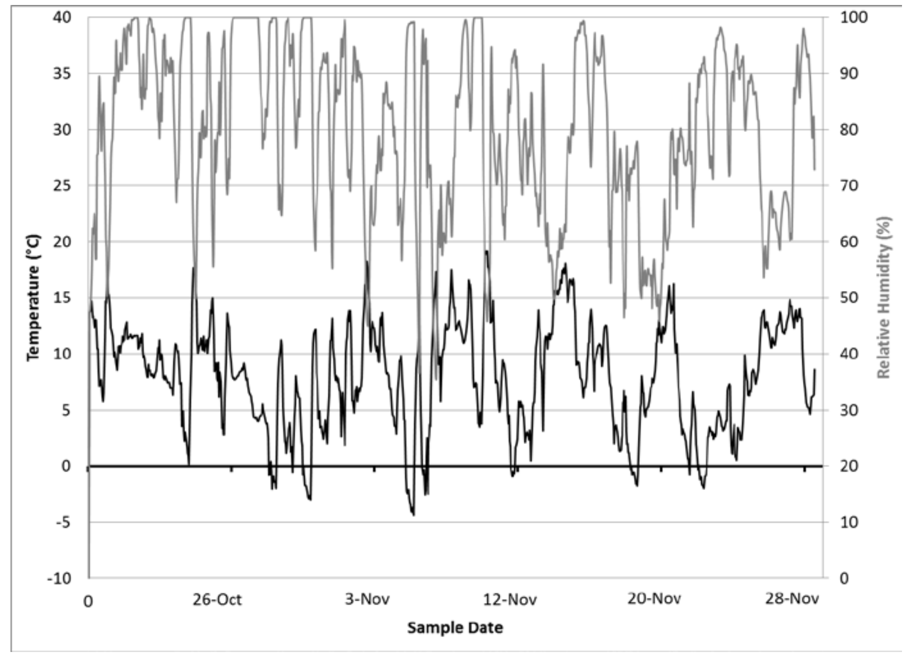
- **Cabernet franc were donated from Pillitteri Estates Winery**
  - 4 X 250 kg sent to 4 drying facilities
  - 1 X 250 kg remained on-vine, netted
  - 1 X 100 kg to serve as control for comparison
- **Target Brix of fruit at harvest: 23ºBrix**
- **Target Brix for drying: 26ºBrix and 28ºBrix**
- **All wines fermented using the same protocol, in triplicate, using EC1118 yeast from Lallemand**

On-Vine Drying: Temperature and Relative Humidity

2012



2011



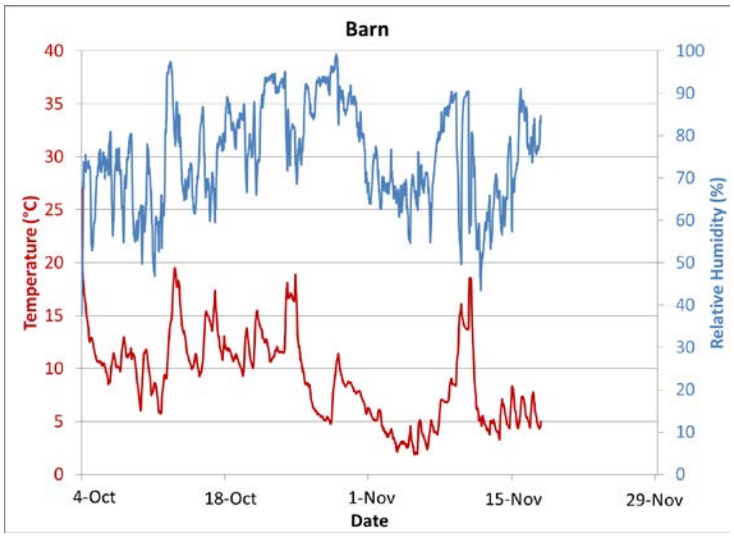
Longest Duration Treatment (2 plus months)

Exposure to climate risks

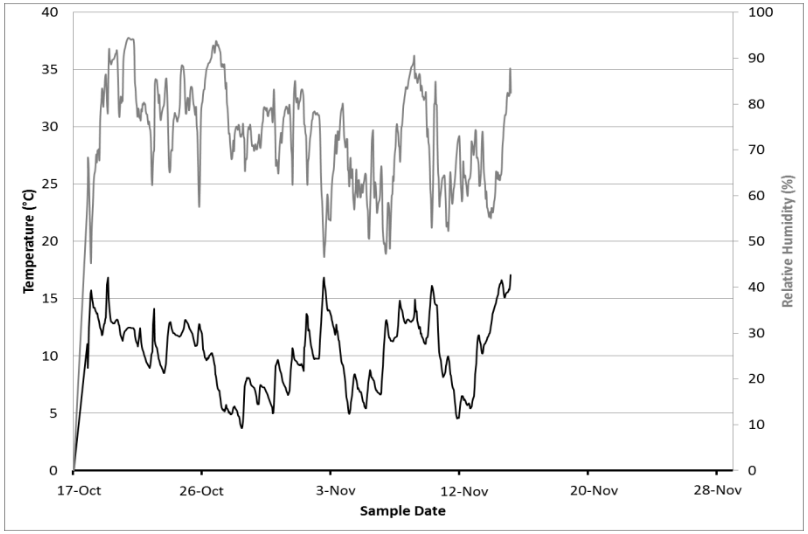
- **Rain, fog, dew, wind, freeze-thaw, wildlife**
- **Highly variable**

Barn Drying: Temperature and Relative Humidity

2012



2011

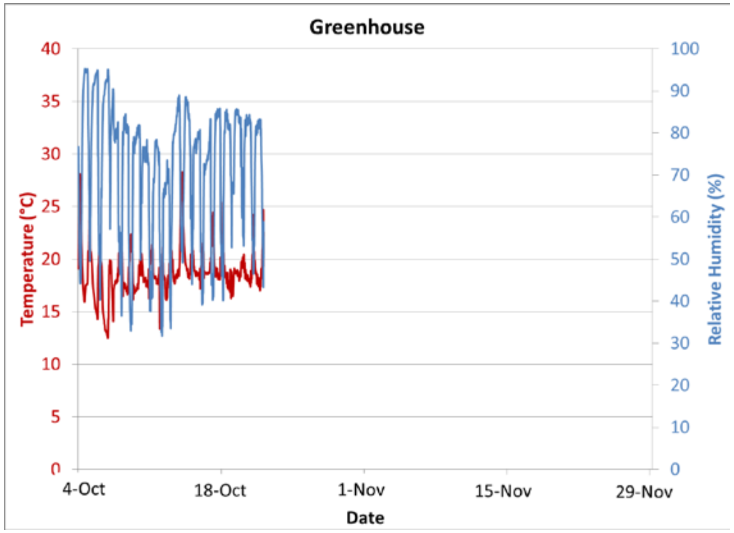


Mid to long term duration (1-2 months)

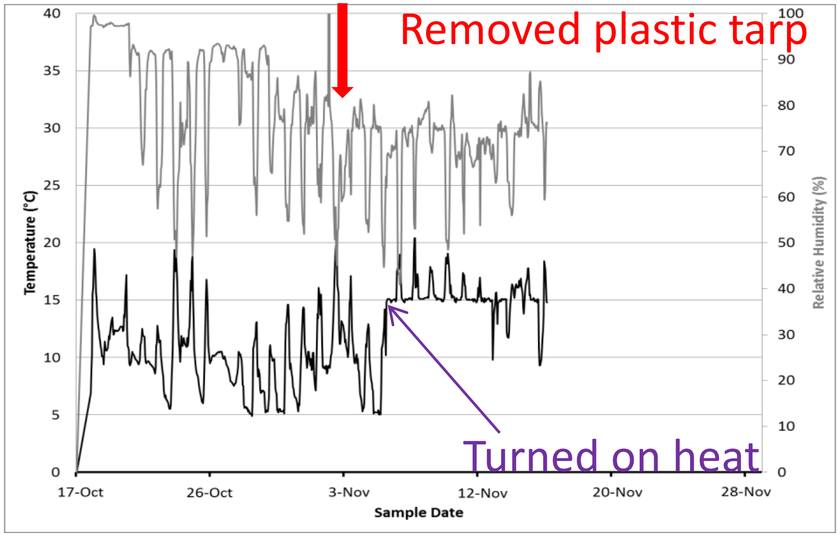
- Protected from rain, wildlife but impacted by external climatic conditions
- Temp and humidity correlated to external climate conditions (r = 0.836)
- Not as variable as on-vine

Greenhouse Drying: Temperature and Relative Humidity

2012



2011



Mid Duration Treatment (weeks)

- Protected from rain, wildlife

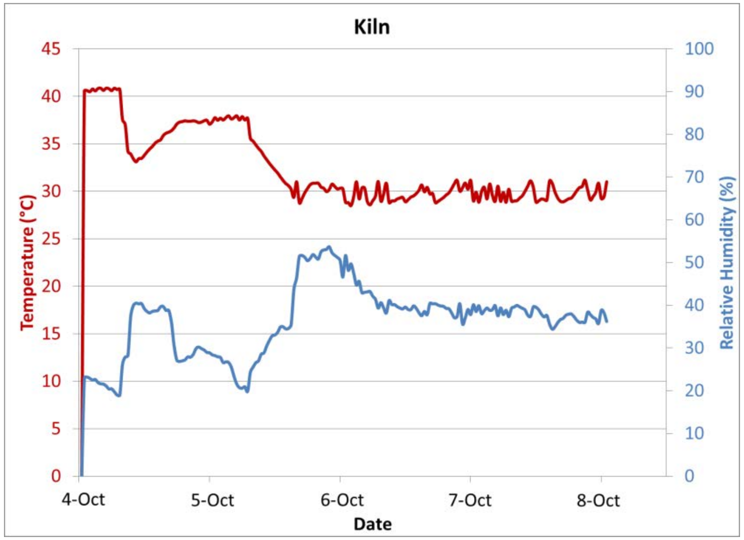
2011, experimental year with plastic tarp over bins

- High humidity, lost grapes to botrytis, one month to dry

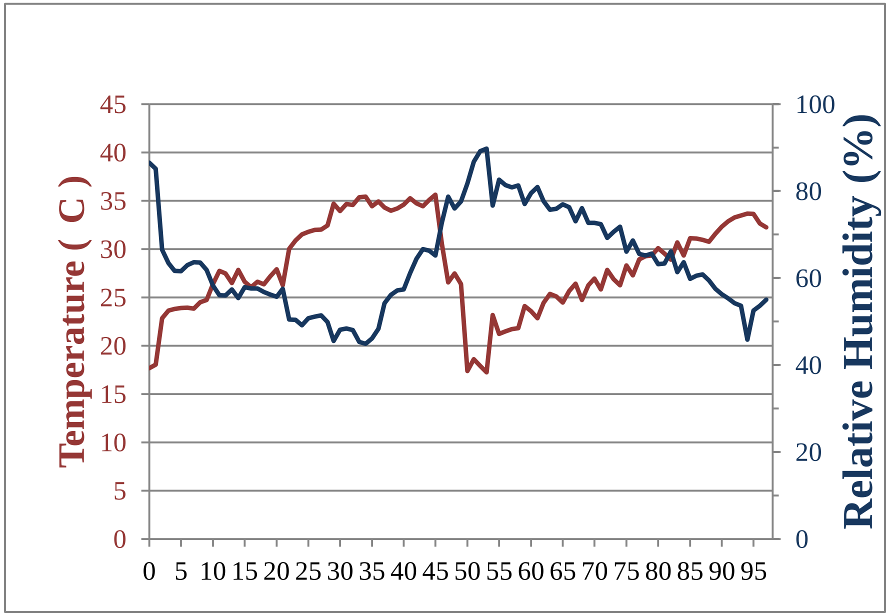
2012, no plastic tarp, grapes on table, good air circulation, worked perfectly, 2 week dry time

Kiln Drying: Temperature and Relative Humidity

2012



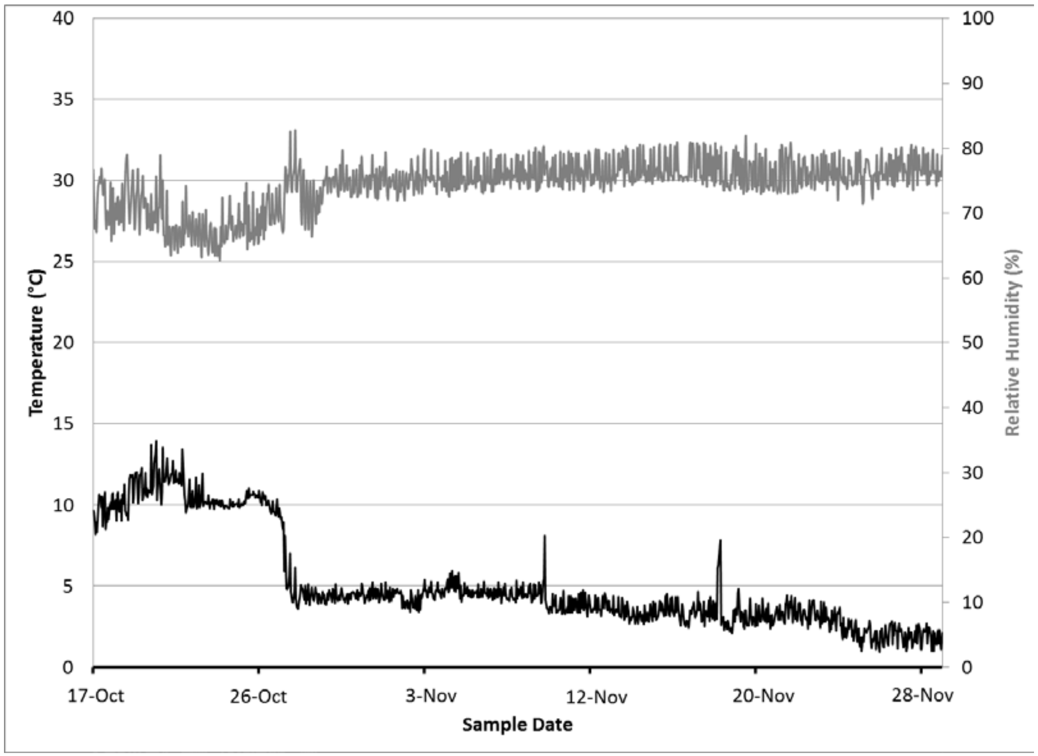
2011



Short duration (days)

- Protected from rain, wildlife
- Not correlated to external climate conditions
- High air flow
- Control temp

Drying Chamber: Temperature and Relative Humidity 2011 only



Long duration

- 22 days to 26 Brix
- 44 days to 28 Brix

Protected from rain, wildlife

No climate influence

Temperature stays low

Humidity stays below 80%

Temperature and relative humidity data for **drying chamber** drying treatment 2011.

Drying treatments require different times to reach target Brix

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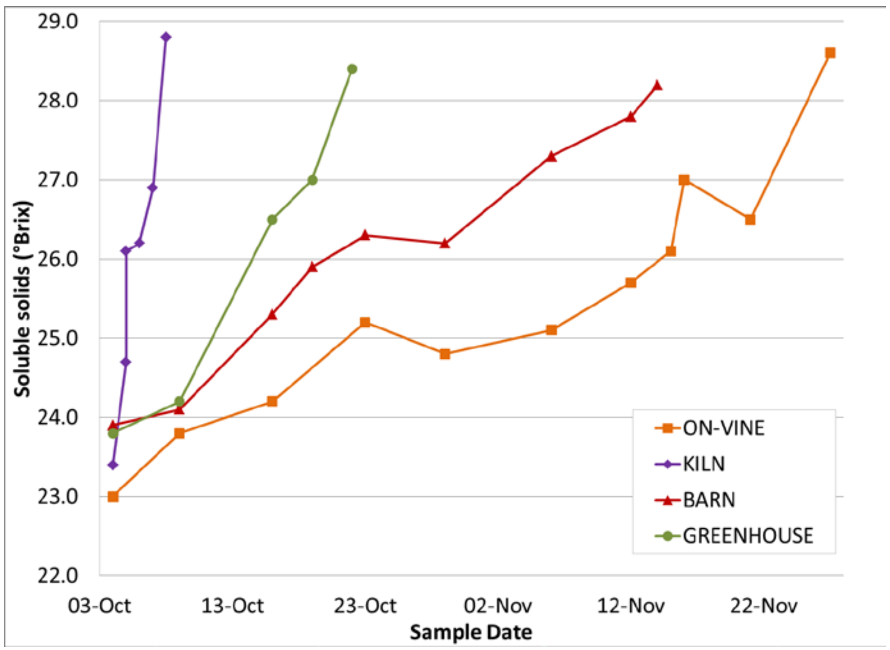
2012



2011

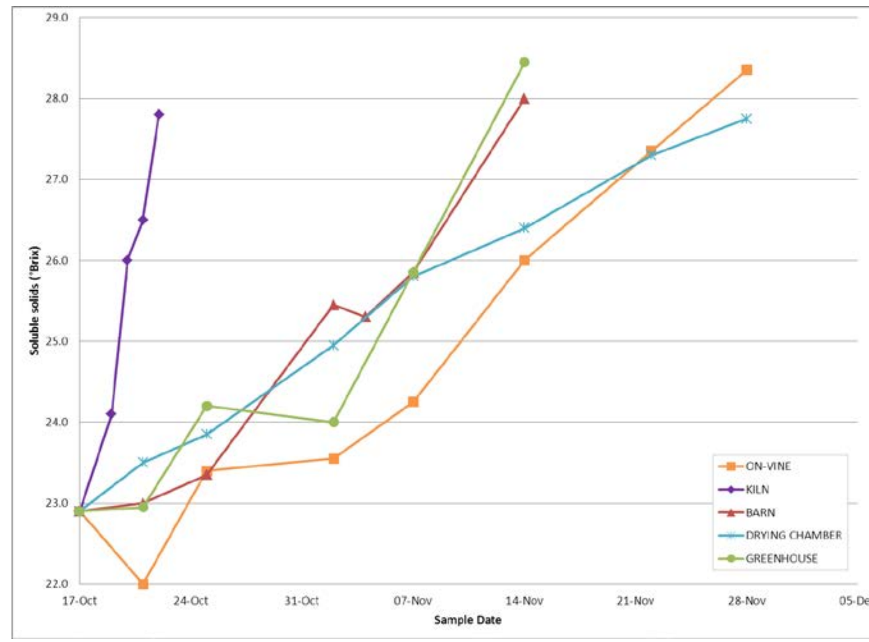


Figure 1. Change in **soluble solids** for drying conditions.

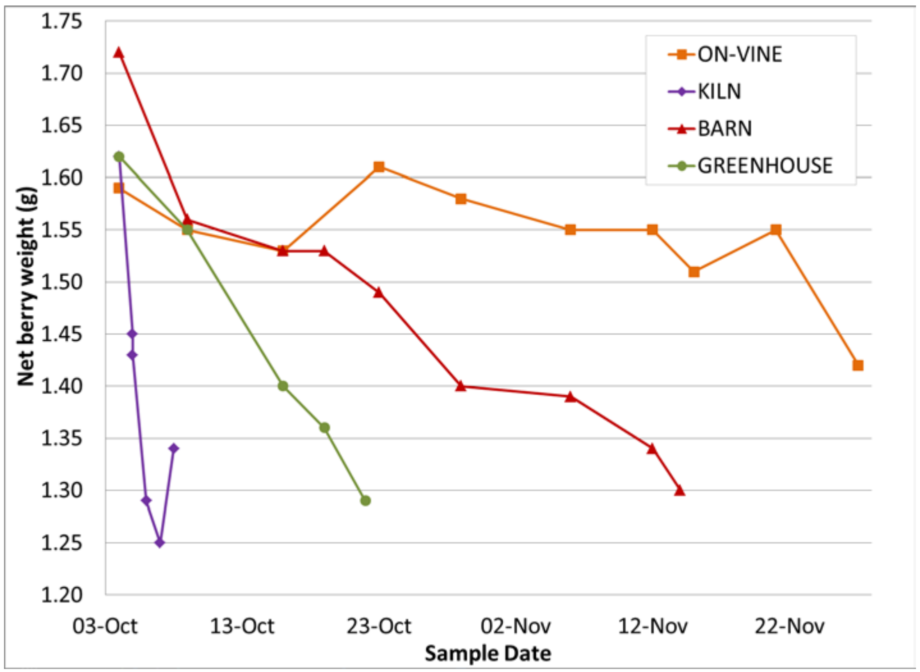
Drying Days to reach 26 Brix and 28 Brix 2011 versus 2012

Harvest date 2011: October 17, 23 Brix
Harvest date 2012: October 4, 23 Brix

Drying Condition	26°Brix Drying Period (days)		28°Brix Drying Period (days)	
	2011	2012	2011	2012
On-Vine	30	43	42	56
Kiln	3	1	5	4
Barn	22	15	29	41
Greenhouse	22	12	29	18
Drying Chamber	22	-	44	-

Weight loss of berries is fairly consistent but varies in time across treatments

2012



2011

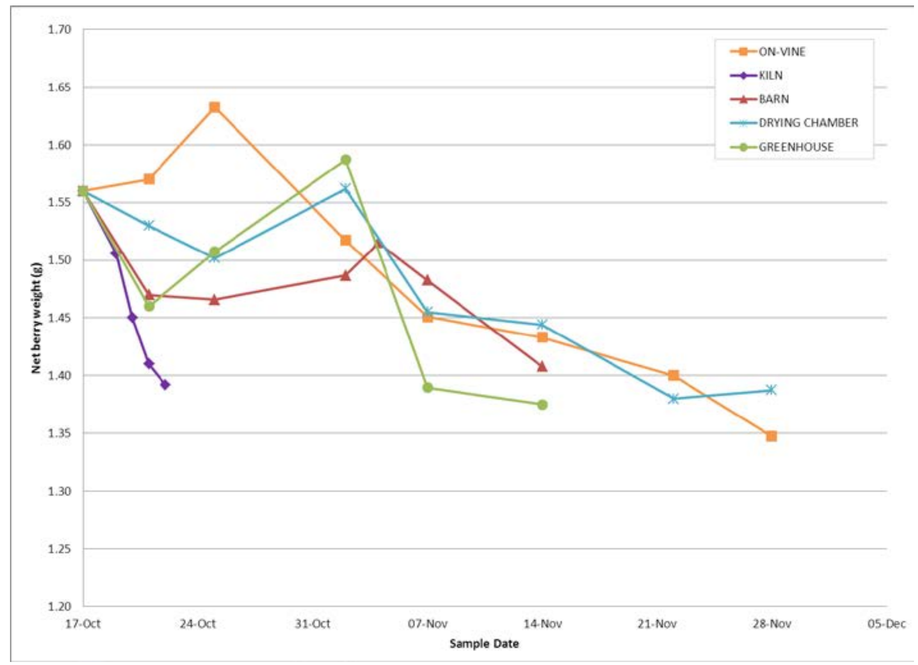


Figure 2. Change in **net berry weight** for drying conditions.
2012- loss of approx 18% weight
2011-loss of approx 11% weight

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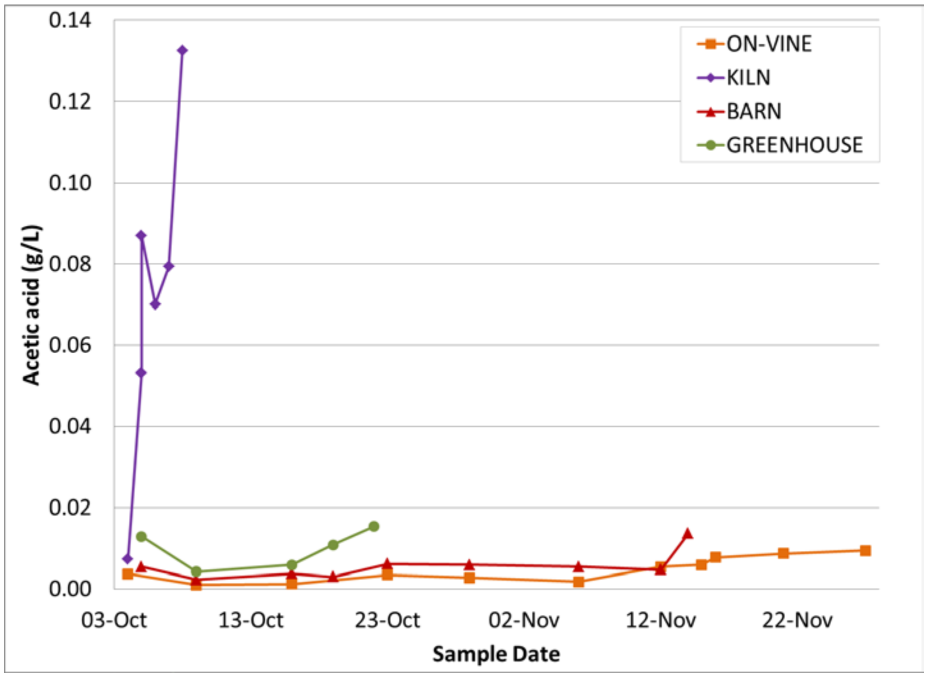
Things to watch for in Appassimento Grape Drying that may impact wine

-increase in oxidation compounds in the grapes like acetic acid, acetaldehyde and ethyl acetate during the drying process

-botrytis grey rot fruit decay from favourable humidity and temperatures

Acetic Acid concentration increases with Kiln drying, something to watch

2012



2011

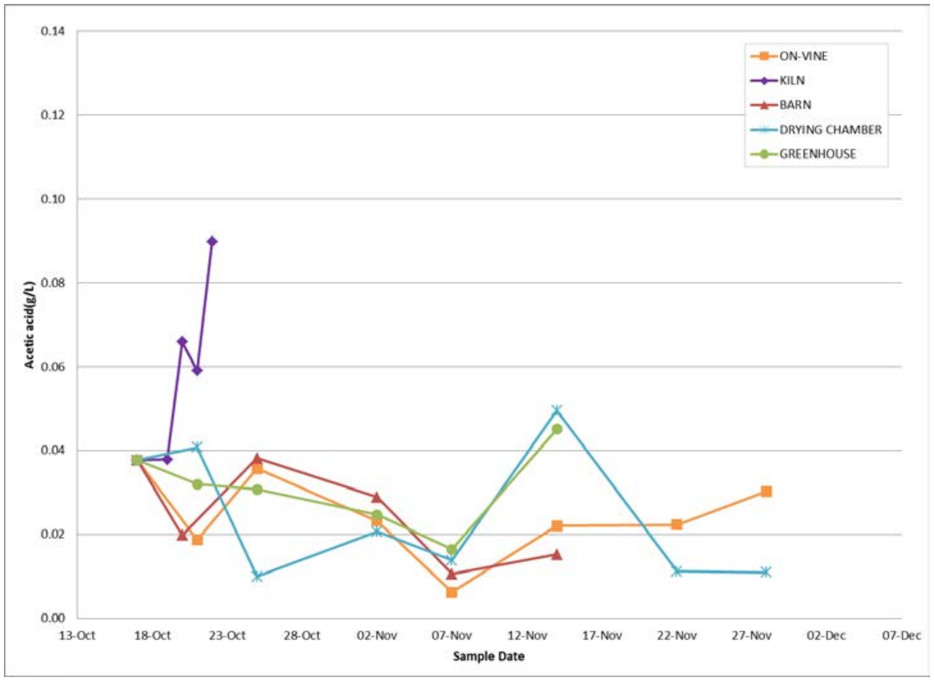
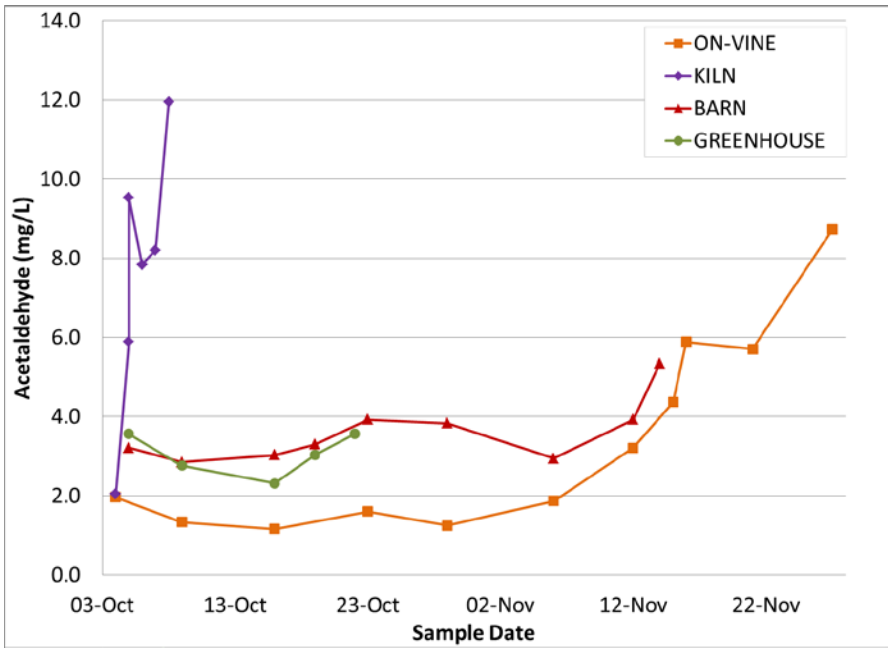


Figure 3. Change in **acetic acid** for drying conditions.

Acetaldehyde increases with all treatments, most evident with On-vine and Kiln drying, but low values

2012



2011

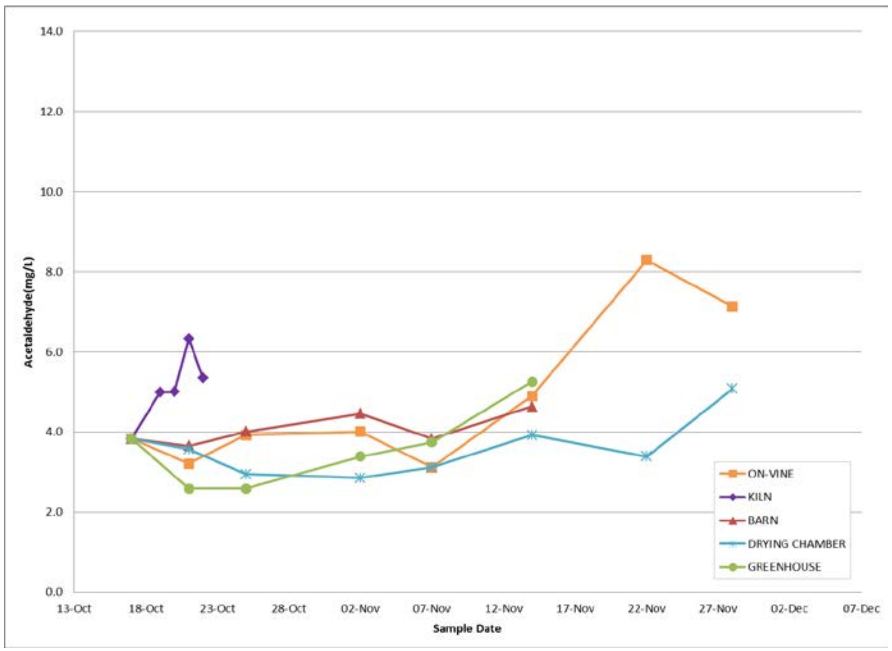


Figure 4. Change in **acetaldehyde** for drying conditions.

Small loss of malic acid, dependant on treatment

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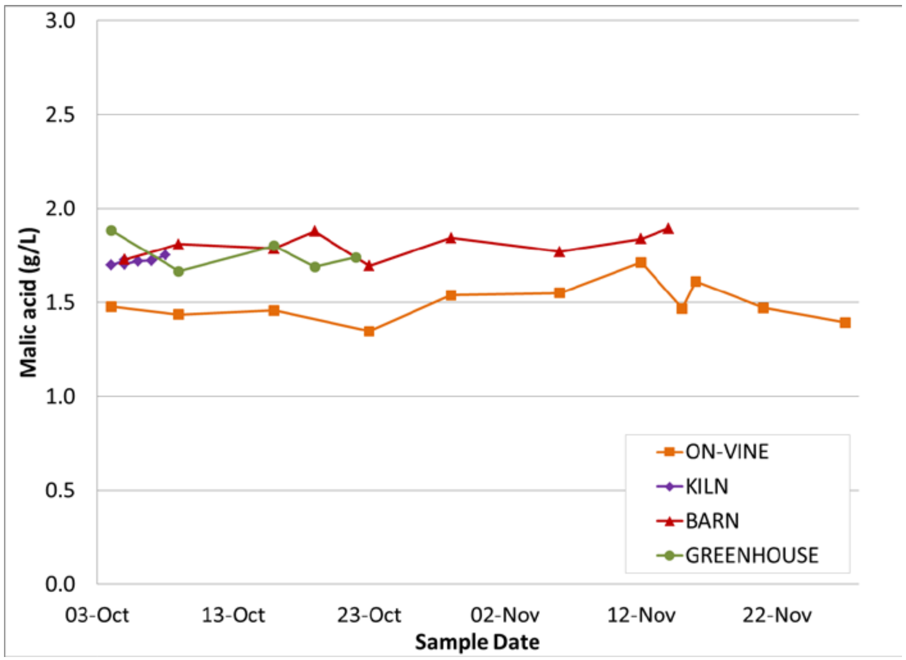
2012



2011

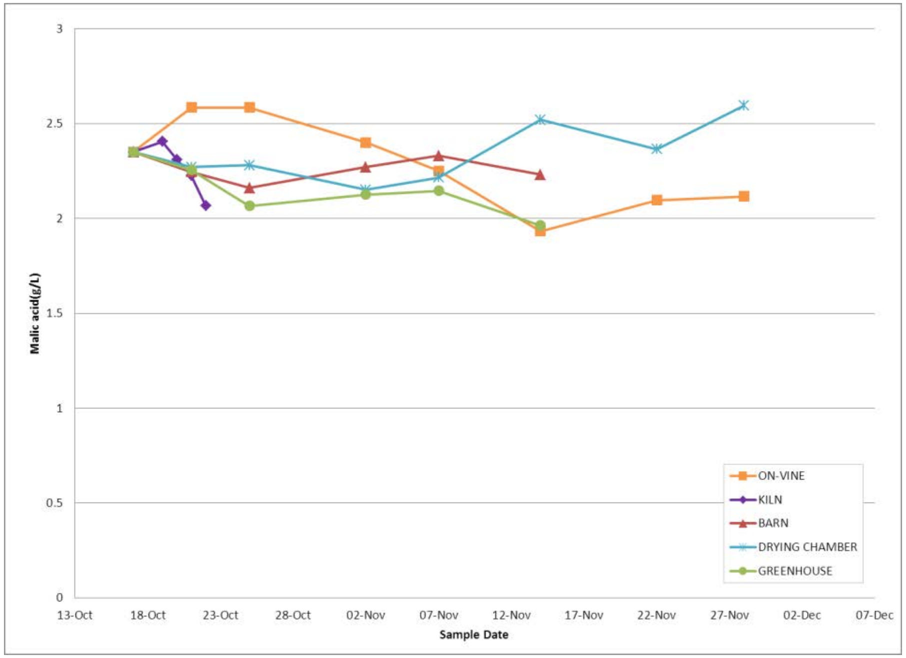


Figure 5. Change in **malic acid** for drying conditions.

Glycerol increases 10 to 20-fold across treatments – 2011 data only

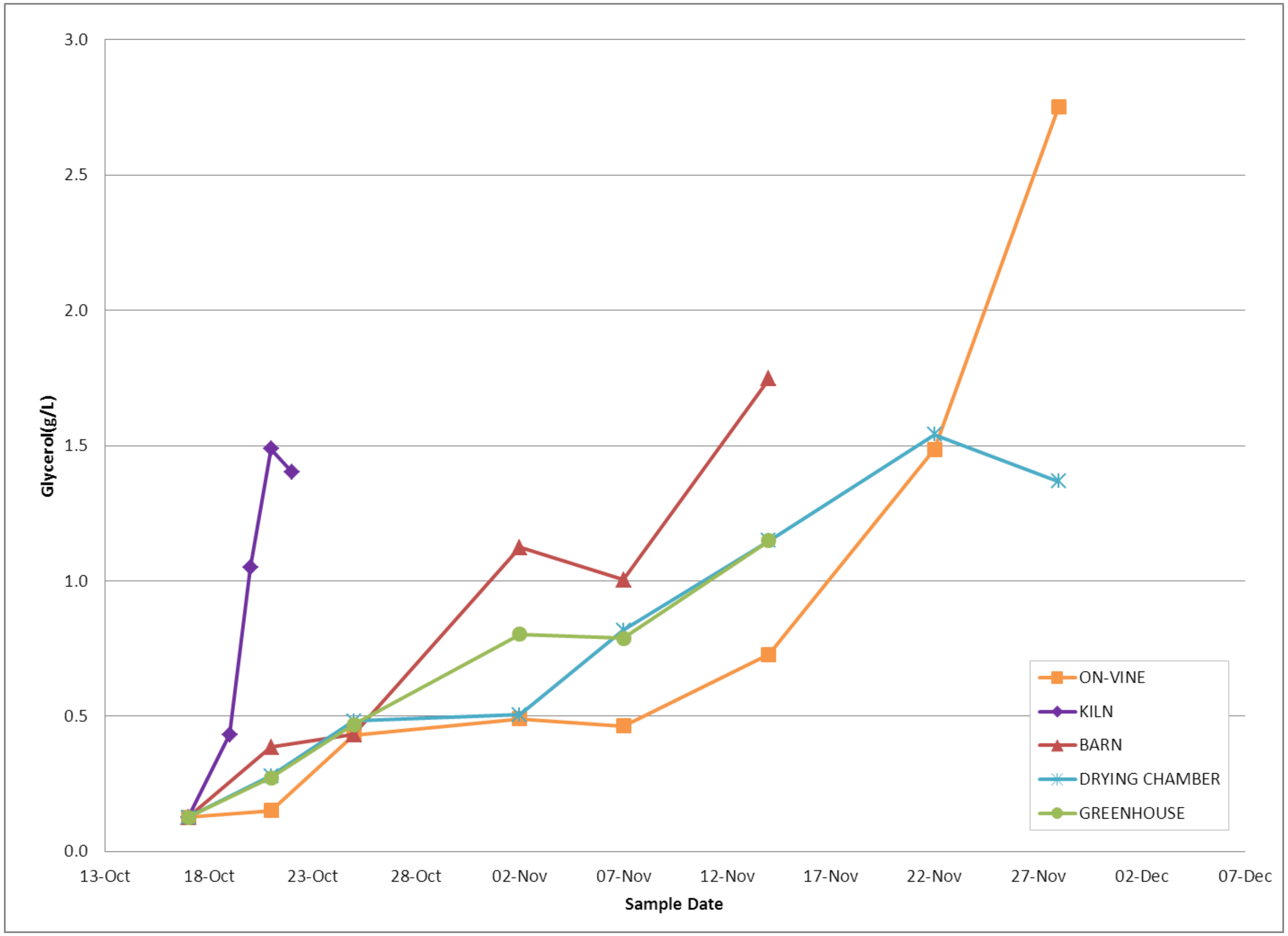


Figure 6. Change in **glycerol** for five drying conditions.

Gluconic acid increases between 2 to 5-fold across treatments – 2011 data only

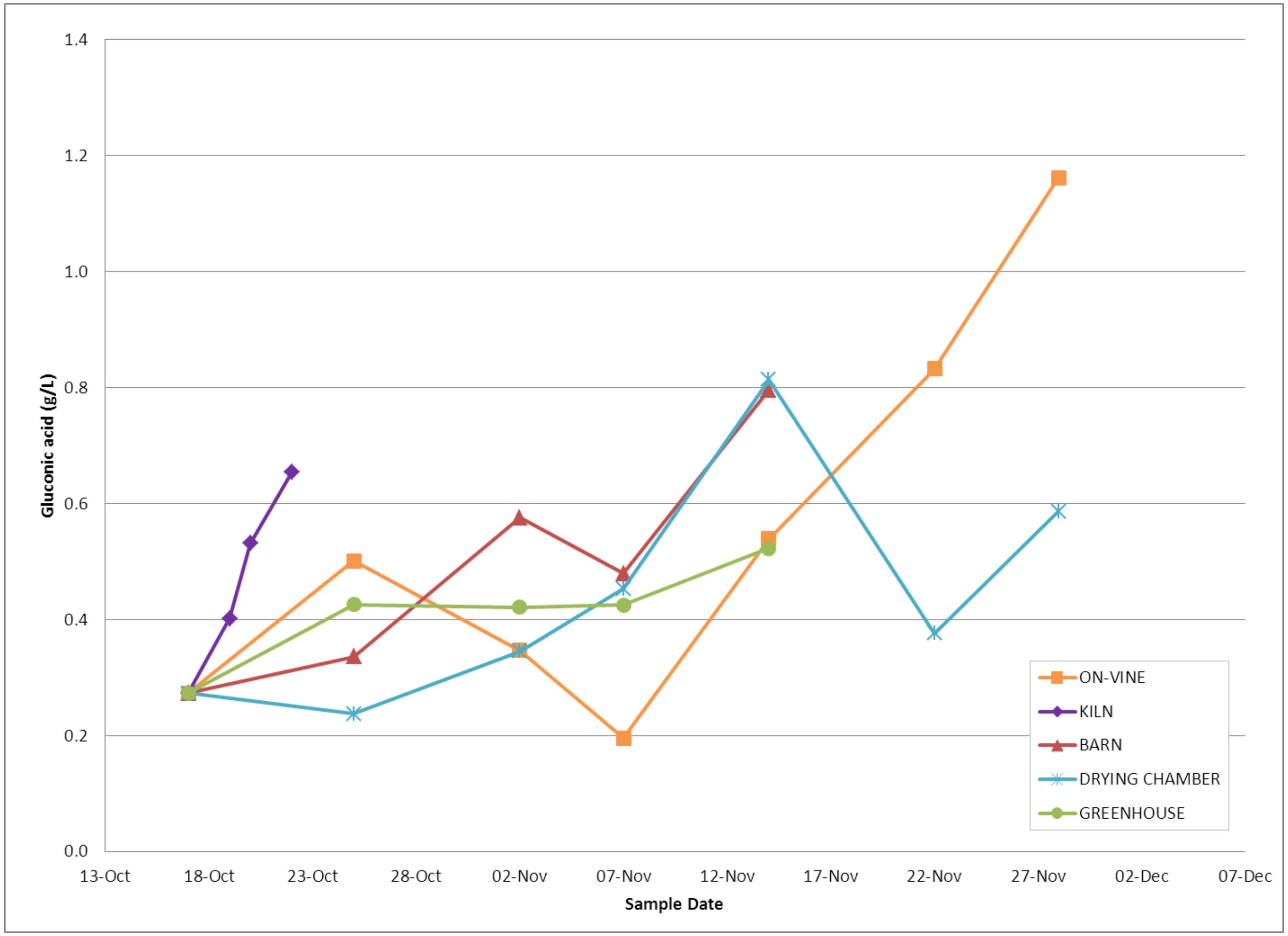
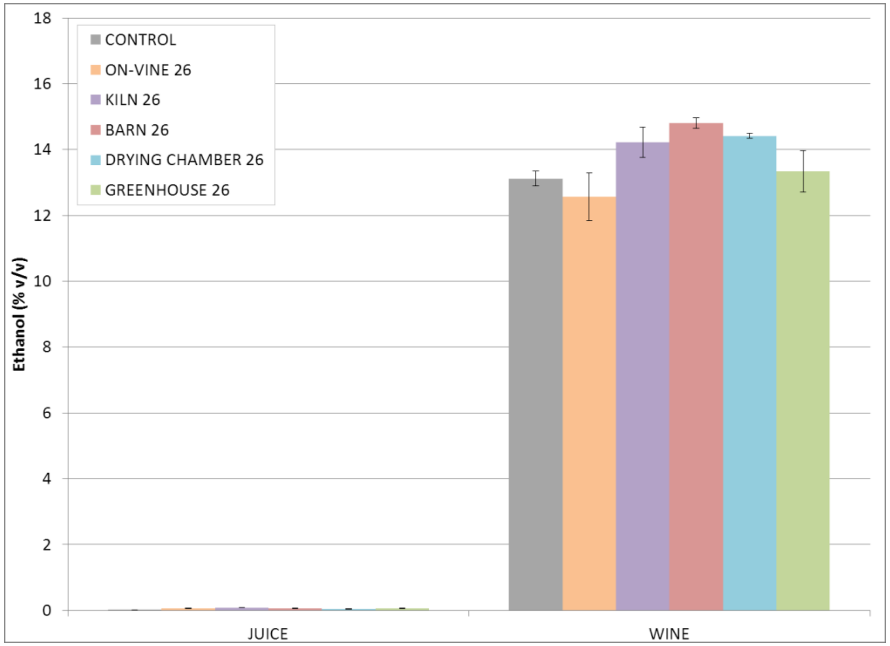


Figure 7. Change in **gluconic acid** for five drying conditions.

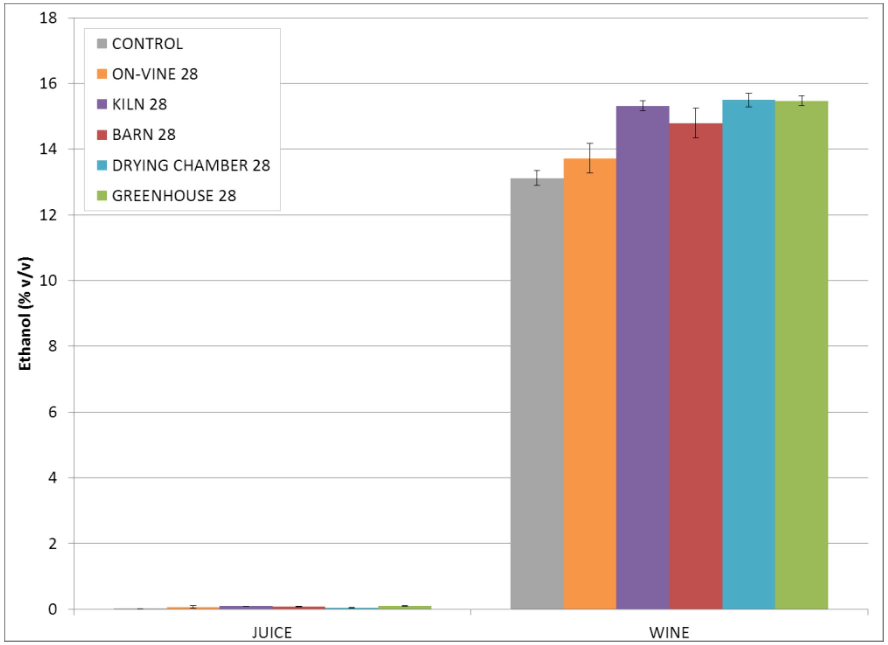
Gluconic acid and glycerol are indicators for botyrtis infection

2011 Wines
Wines fermented at 26°brix had 12-14.5% v/v ethanol
Wines fermented at 28°brix had 14-15.5% v/v ethanol

26°Brix



28°Brix



Figures 8a & 8b. Change in **ethanol** from juice to wine, for Control harvest and harvests at 26°Brix (left) and 28°Brix (right), from five drying conditions.

2011 Wines
Acetaldehyde concentrations were highest in Barn Treatment, lowest for on-Vine

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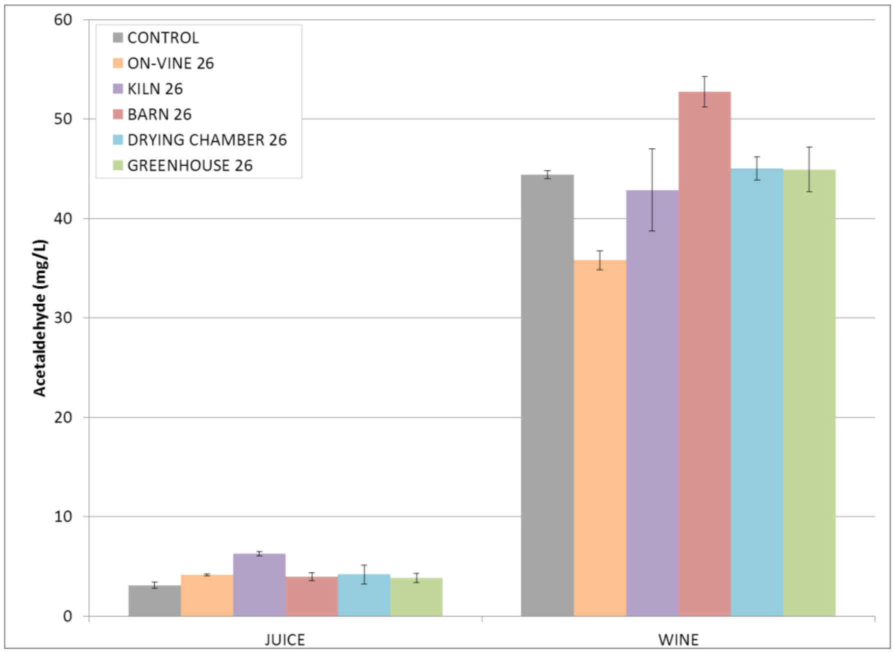
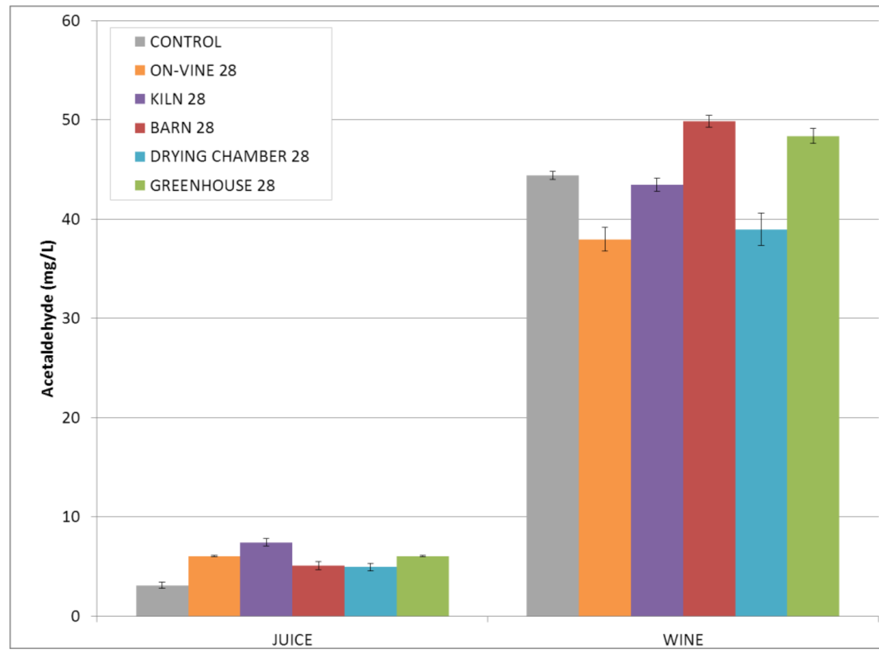
26°Brix



28°Brix



Figures 9a & 9b. Change in **acetaldehyde** from juice to wine, for Control harvest and harvests at 26°Brix (left) and 28°Brix (right), from five drying conditions.

2011 Wines
Acetic acid in wines varied from the control, depending on drying treatment

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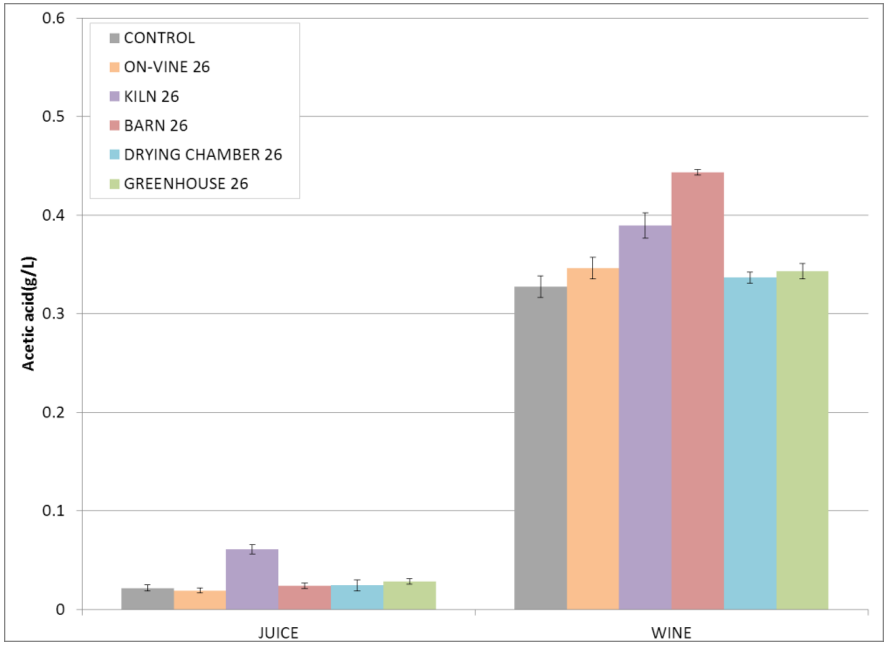
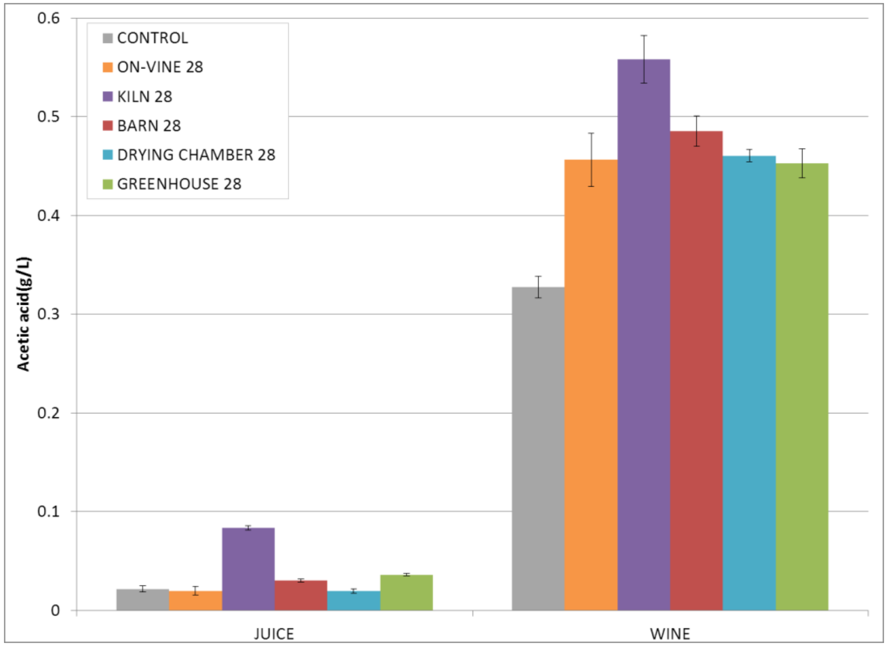
26°Brix



28°Brix



Figures 10a & 10b. Change in **acetic acid** from juice to wine, for Control harvest and harvests at 26°Brix (left) and 28°Brix (right), from five drying conditions.

2011 Wines
Ethyl acetate concentrations were elevated using kiln and barn-dried fruit

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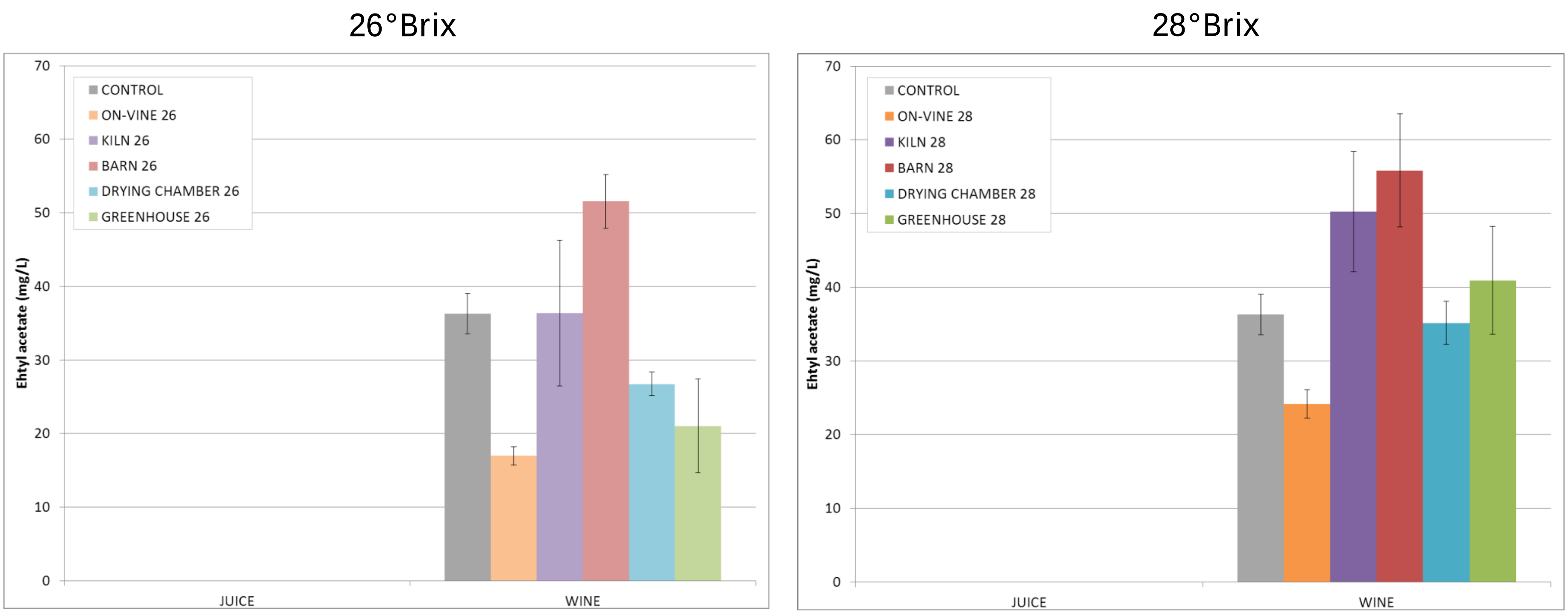
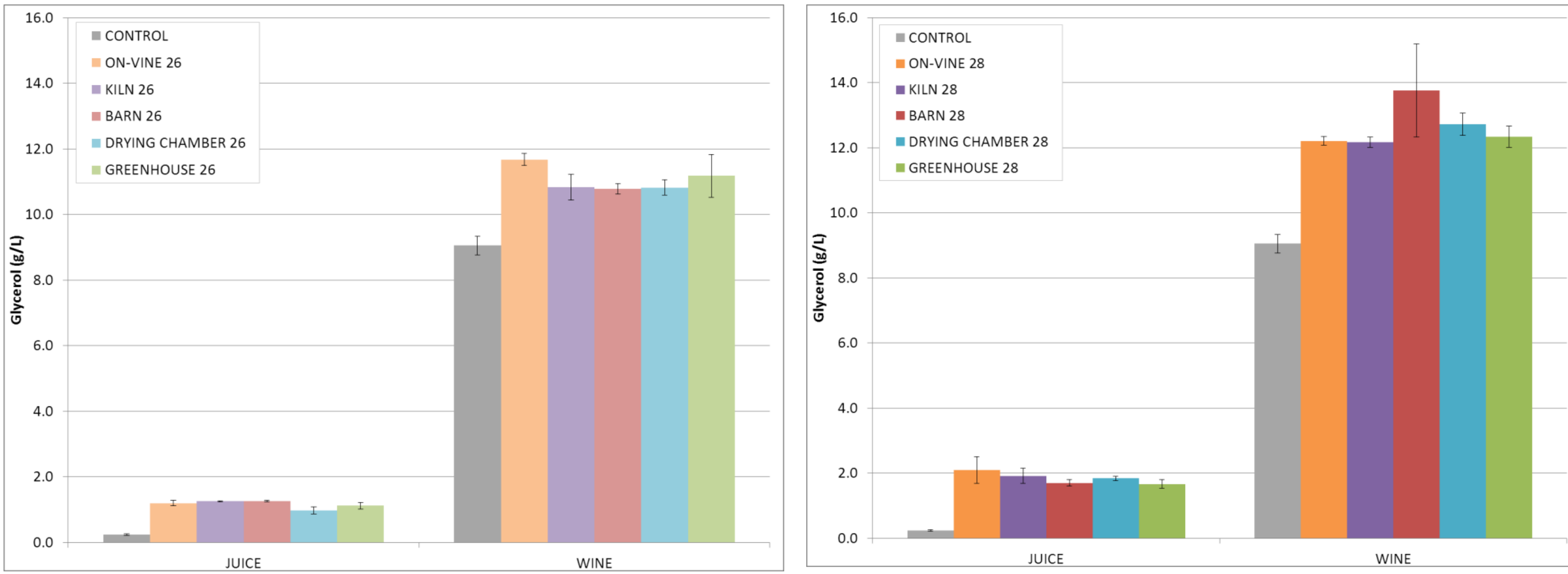


Figures 11a & 11b. Change in **ethyl acetate** from juice to wine, for Control harvest and harvests at 26°Brix (left) and 28°Brix (right), from five drying conditions.

2011 Wines
Glycerol values were elevated in wines from drying treatments

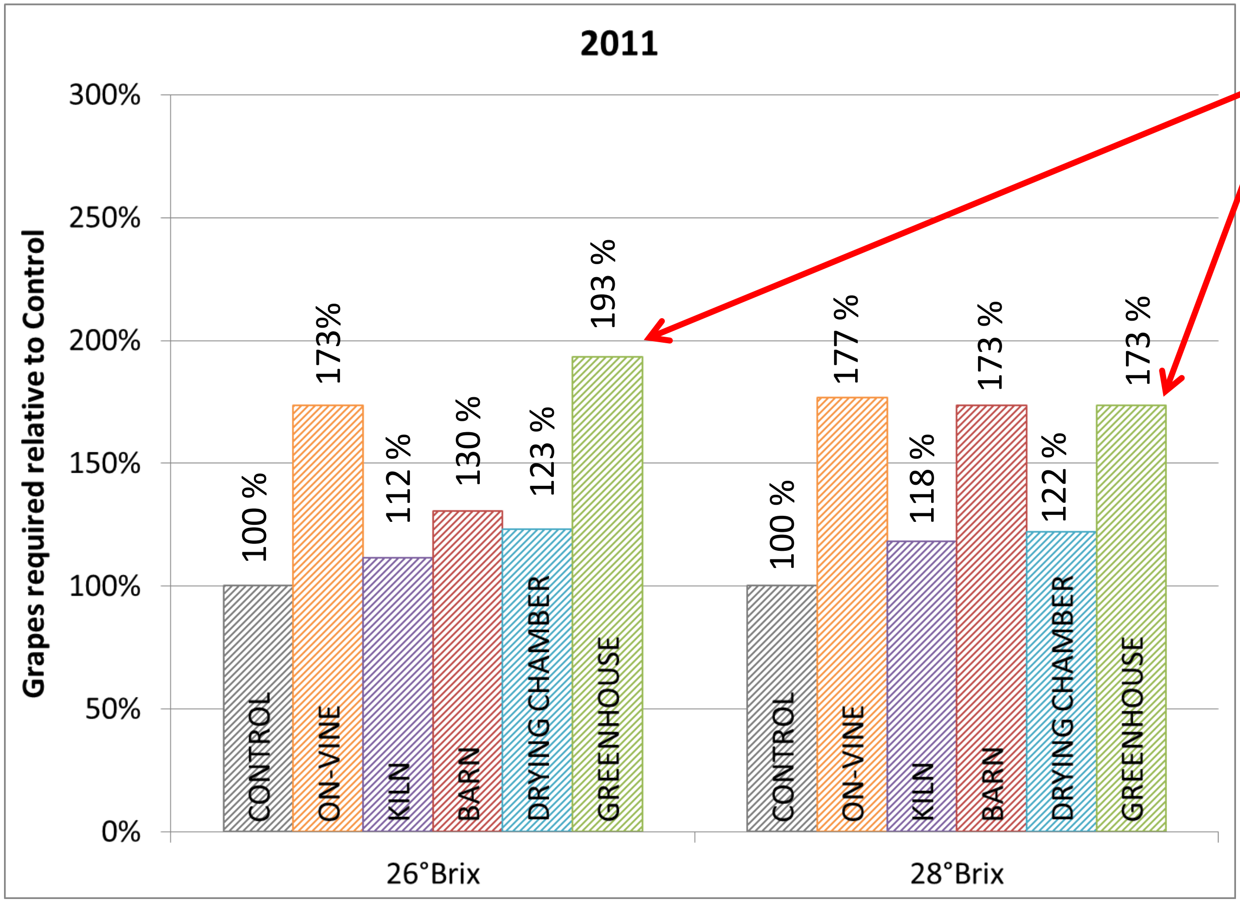
26°Brix 28°Brix



Figures 12a & 12b. Change in **glycerol** from juice to wine, for Control harvest and harvests at 26°Brix (left) and 28°Brix (right), from five drying conditions.

Preliminary cost analysis 2011

- to generate the same must volume as the control for the various treatments, what % increase in grapes are required?



Green house artificially elevated due to mass culling Nov 3

Kiln treatment had least losses, just dehydration of fruit

On-vine had highest losses due to fruit decay

Preliminary cost analysis 2012

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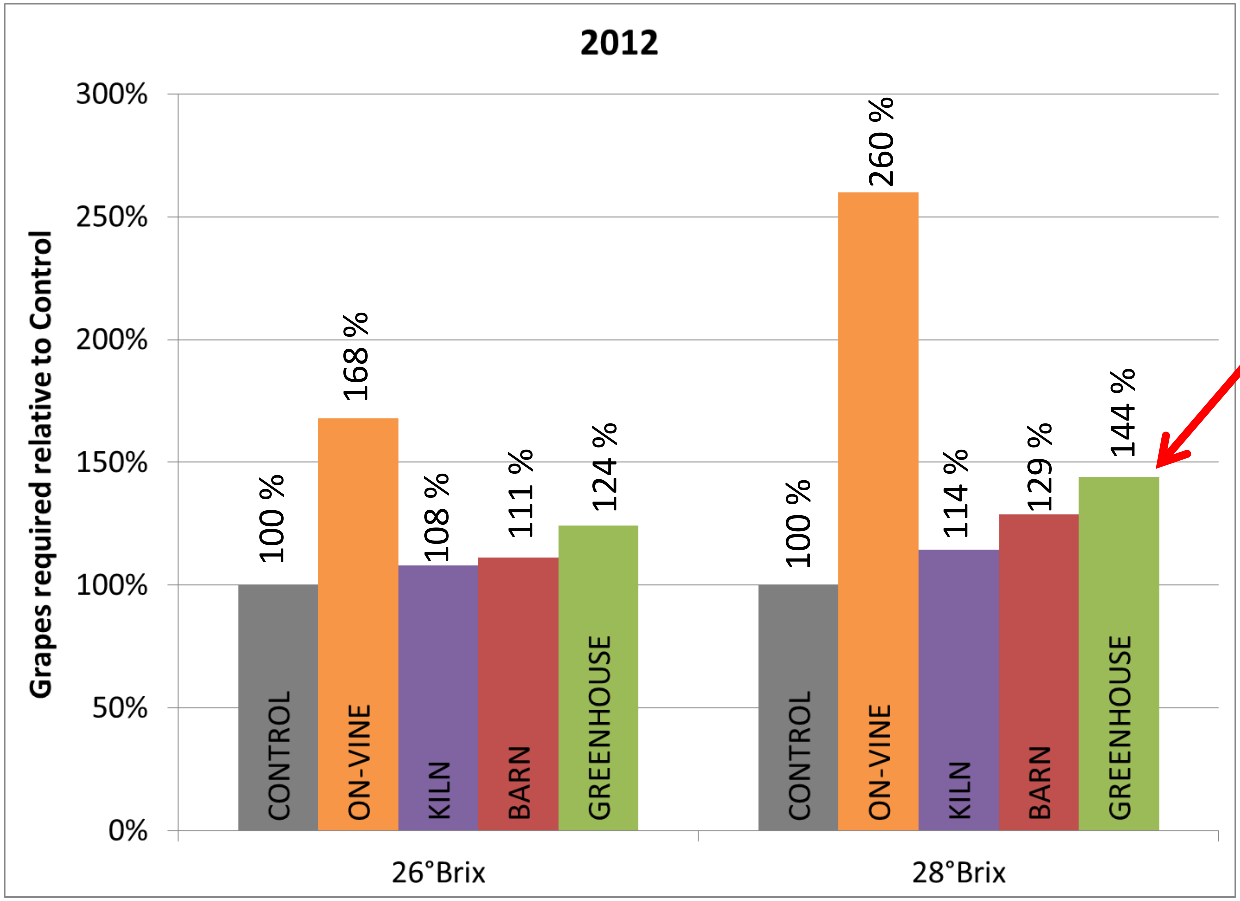
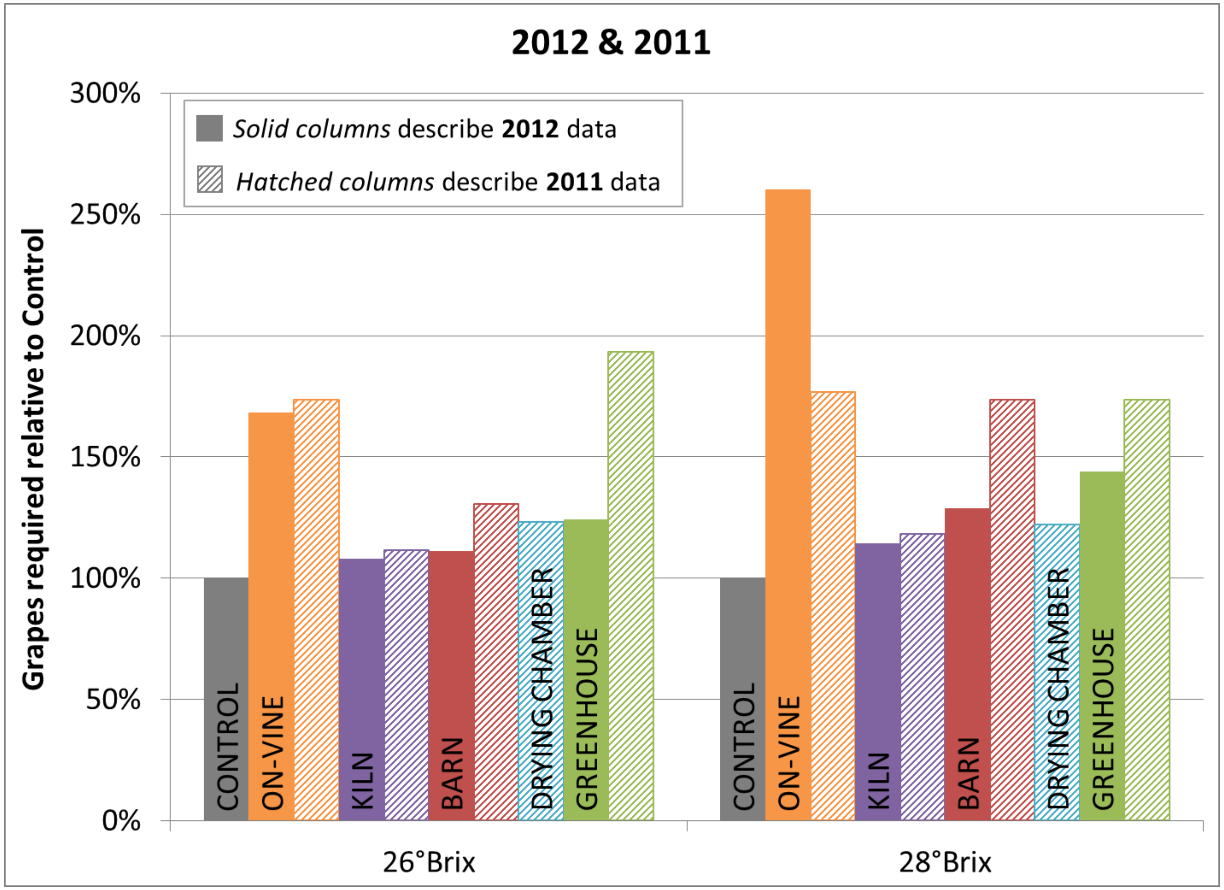
- **to generate the same must volume as the control for the various treatments, what % increase in grapes are required?**



Artificially high, Loss due to wildlife (racoons like appassimento grapes too!)

Preliminary cost analysis 2012 vs 2011

- to generate the same must volume as the control for the various treatments, what % increase in grapes are required?



Next Steps

- Complete data analysis of Sensory evaluation of 2011 wines
- Bottle 2012 wines, complete sensory evaluation
- Compile rest of chemical analysis data for 2012 wines
- Complete summary of microbial analysis from 2012

Botrytis Side Project in 2012

- Role of Botrytis in adding complexity to wines
  - should we always discard botrytis infected fruit or should we assess the impact of botrytis affected fruit on wine profile
  - recent research points to role of some botrytis infected fruit to add complexity in appassimento wines - noble rot form not grey rot form
  - In 2012, we wanted to make wine with 10% or 20% botrytis infected fruit versus no botrytis infected fruit to see impact on wine
    - Experiment planned using barn dried fruit
    - Tried to develop a visual key to separate botrytis from non-botrytis infected fruit

Botrytis infected fruit

No botrytis

Botrytis, grey rot form

Botrytis, noble rot form

Tosi et al, 2008

Our Five Categories based on colour and physical appearance

Black

Sporulating control

Black withered

Red

Red Withered

Separated fruit into 5 categories incubated in humid chamber, room temperature to induce botrytis

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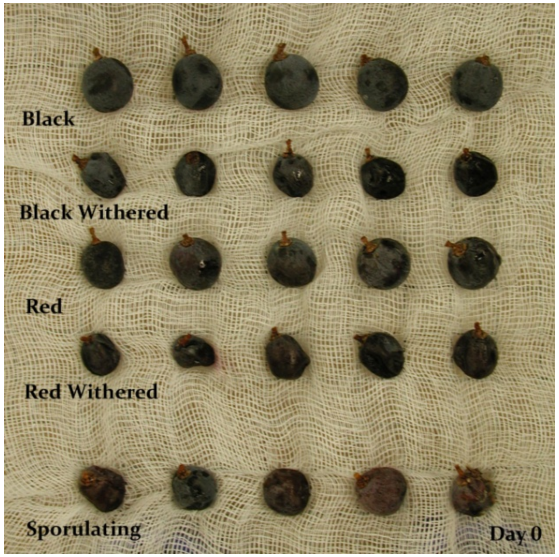
Day 0



Day 7

Berries from each category were plated out, botrytis only found in sporulating positive control

After 7 days of incubation, only botrytis found in sporulating positive control

Botrytis Experiment Continued

- First tray tested in November, no botrytis found in any berry categories except the positive sporulating control
  - Berries with red hue under bright light were under-ripe berries as verified via Brix testing and from glycerol and gluconic acid testing
- 2nd tray tested in December, similar result
- Third tray tested in January, similar result
- Fruit from Pillitteri did not contain sufficient botrytis inoculum for the experiment in 2012
- Try for 2013

Planning for 2013, 2014

- Variety – Cab franc?
- Role of Botrytis in adding complexity to wines
  - Indigenous botrytis or seed for infection?
- Modifications to drying treatments (Kiln and Greenhouse)?
- Brock Isolate yeast for Ontario Appassimento wines
- Continue with cost analysis

Summary

- Appassimento process for wine production in Ontario shows great promise for further ripening grapes post-harvest to produce full-bodied red wines
- The drying process does impact the resultant wine flavour moderated through differences in grape biochemistry changes and microflora changes on the berries during the drying process
- Drying facilities repurposed from other industries such as Tobacco Kilns and Greenhouses result in wines with unique characteristics
- Ripening grapes off-vine after harvest represents a new and exciting innovation for the Ontario wine industry to not only overcome climatic barriers to obtaining fully ripe grapes, but to developing a unique signature wine style for Ontario.
- The semi-dried fruit can then be fermented into an appassimento-style wine, similar to Amarone, using varieties grown here in Ontario to produce value-added quality-driven unique products with distinctive flavour profiles.

Partners

VRIC

- Michael Brownbridge, Bernard Goyette, Jianbo Lu
- Irina Perez-Valdes (mold analysis)
- Harvest team from Cherry Ave

Niagara College

- Terence van Rooyen, students, staff

CCOVI

- Gary Pickering, Vincenzo DeLuca, Jim Willwerth, Debra Inglis
- Lisa Dowling (Berry sampling, analysis)
- CCOVI Harvest team
- Kyung-Hee Kim, Linda Tremblay, Lynda van Zuiden (chemical analysis)
- Fred Diprofio for wine making
- Ian Bock (environmental and economic analysis, botrytis trial)
- Cristina Huber (microbial analysis)

Industry

- **Pillitteri Estates Winery**
- **Cave Spring Cellars**
- **Reif Estate Winery**
- **European Planters**
- **Sunrise Greenhouses**
- **Integra (Graham Rennie)**
- **Grape Growers of Ontario**
- **Ontario Grape and Wine Research Inc**

Government

- **Ontario Ministry of Economic Development and Innovation (ORF RE)**
- **Agriculture and Agrifood Canada (DIAP)**

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Thank you

Cheers!

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