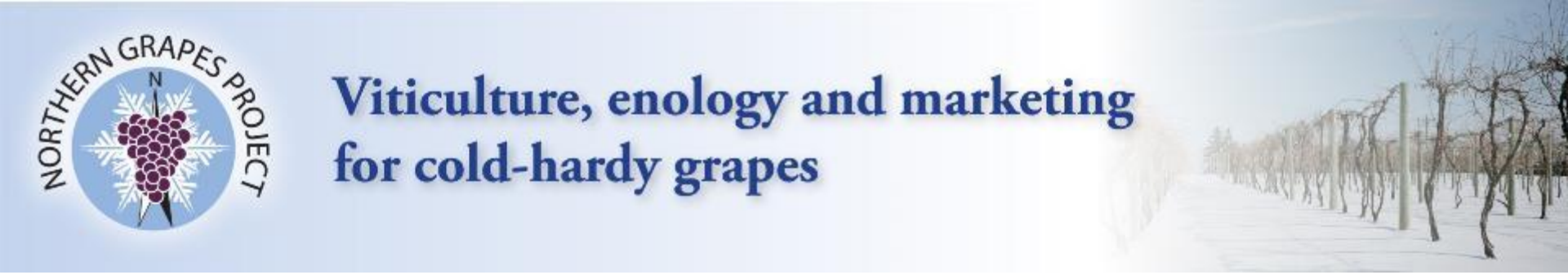

Impact of Crop Load and Training Systems on Marquette in Michigan: Summary of 2012-2016 activities at MSU

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The Northern Grapes Project is funded by the USDA's Specialty Crops Research Initiative Program of the National Institute for Food and Agriculture, Project #2011-51181-30850

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- Horticulture Teaching and Research Center (Bill Chase and Tom Fernandez)

Flying Otter Winery

Bob Utter

Northern Grapes Project

Summary of Activities at MSU from 2012 to 2016

- Experimental activity
- 3 locations: Southwest Michigan Research and Extension Center (SWMREC) Benton Harbor, Horticulture Teaching and Research Center (East Lansing) and Flying Otter Vineyard and Winery (Adrian)
- Experiments on:
  - Trellis systems
  - Crop load
  - Canopy management

Outline

- Marquette in Michigan
  - The role of cold hardy CVs in expanding the MI grape and wine industry
- Working on trellis systems and crop load: Why?
  - High sugar and high acids, looking for a balance to produce high quality wines; coupling fruit technological maturity parameters
- 2012: impact of spring frost on yield and fruit quality
  - Early ripe good for cool climate, but early bud-burst subjected to spring frost
- 2012-2016: the role of (a) trellis system and (b) yield per vine and (c) canopy management on fruit technological maturity at harvest and wine sensory components

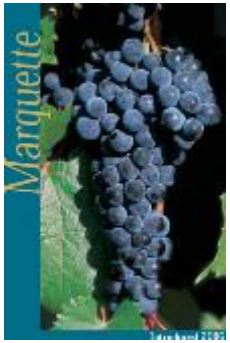
Marquette in Michigan

The role of cold hardy CVs in expanding the MI grape and wine industry

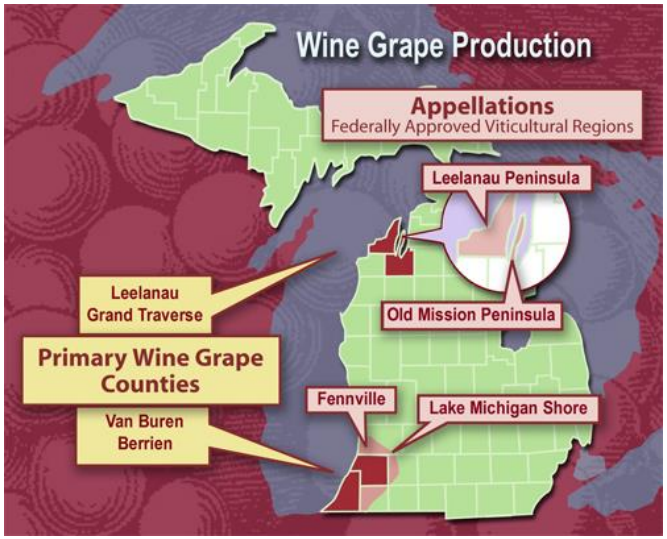
Variety Category	2015	
	Acres	%
Concord	8,030	*59*
Niagara	2,830	*21*
Hybrids	760	*6*
Viniferas	2,040	*15*
Total	**13,660**	

5Th Appellation Established in 2016:

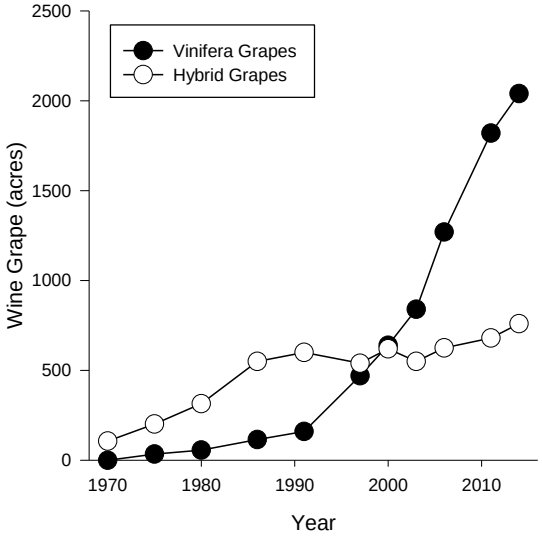
"Tip of the Mitt"



- The 2014 USDA report 27 acres of Marquette in MI.
- Marquette was recently planted in MI, accounting for 40% of the new hybrid acreage.



http://www.michiganwines.com

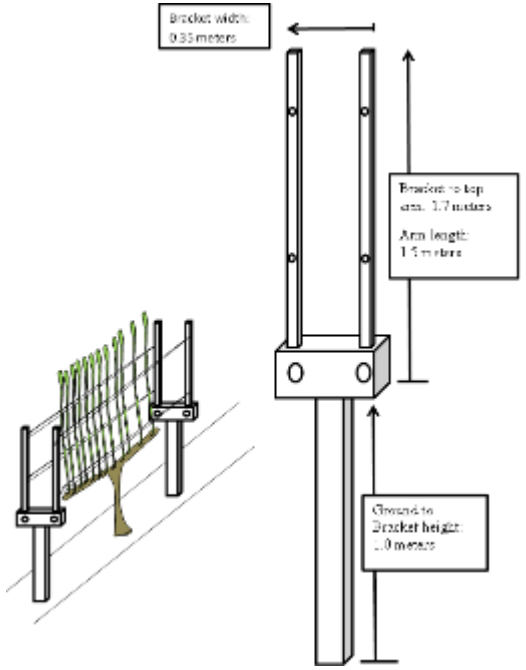


Acres of vinifera to hybrid grapes in Michigan. Elaborated from USDA-NASS (2014). From Sabbatini and Howell. *Vitis Hybrids: History and Current Status.* Wines & Vines, January 2014.

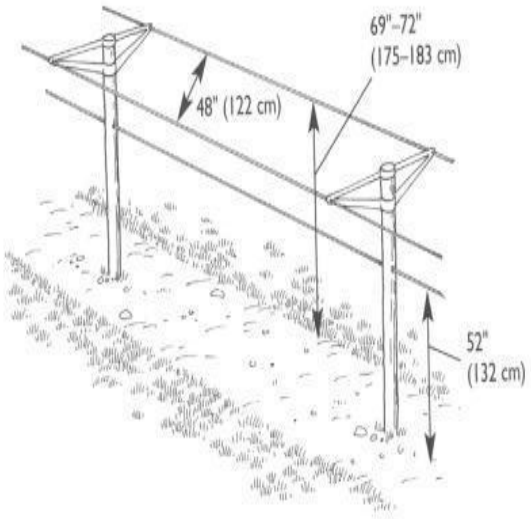
Data from USDA 2015 Fruit Inventory Report

Training Systems Trial

High Wire Cordon (HWC)



Geneva Double Curtain (GDC)

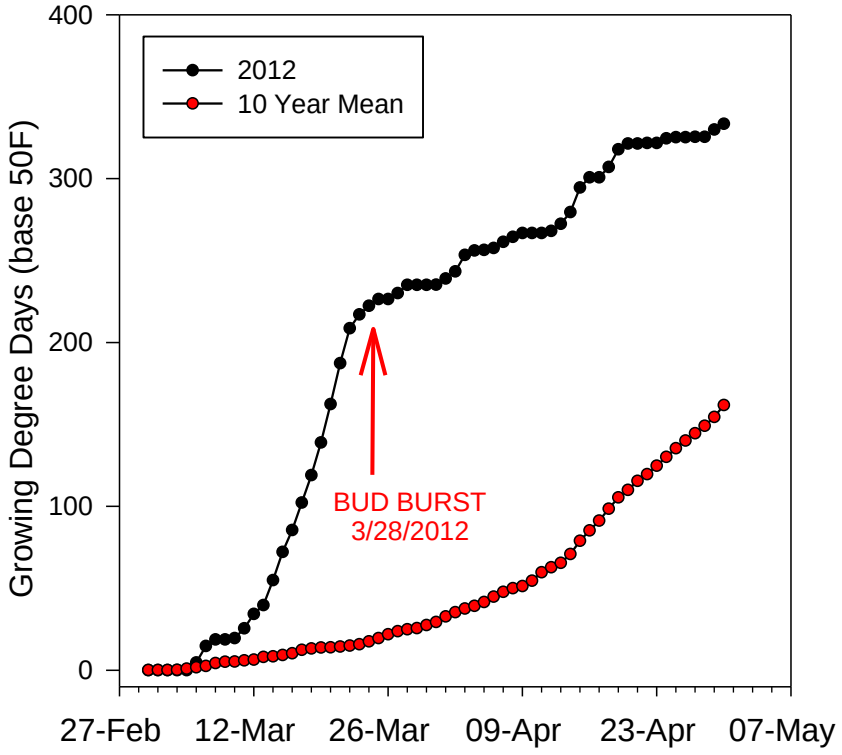


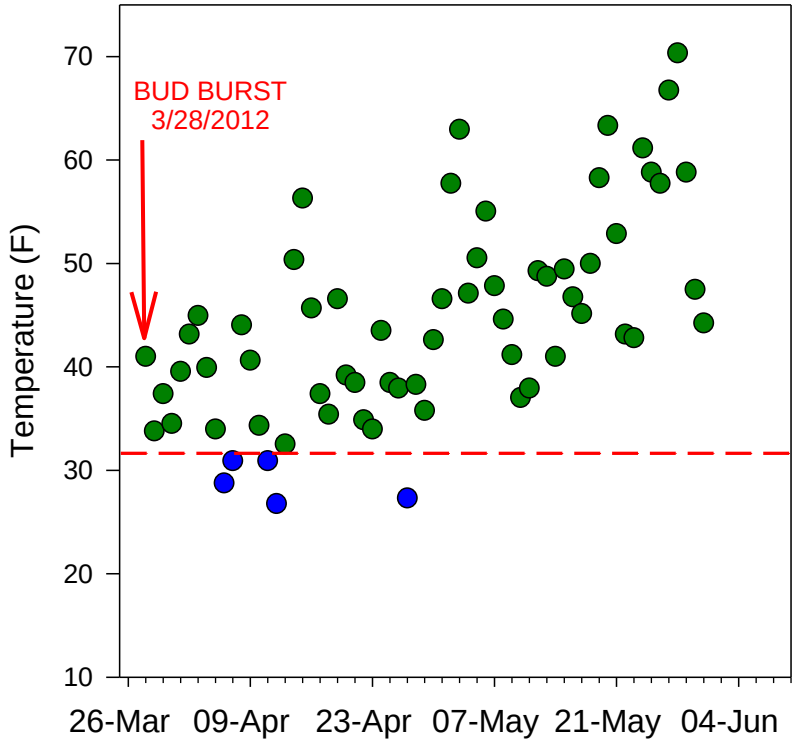
Moving Trellis (MT)

Palliotti, A. 2011. A new closing Y-shaped training system for grapevines. AJGWR, Vol 18: pp 57-63

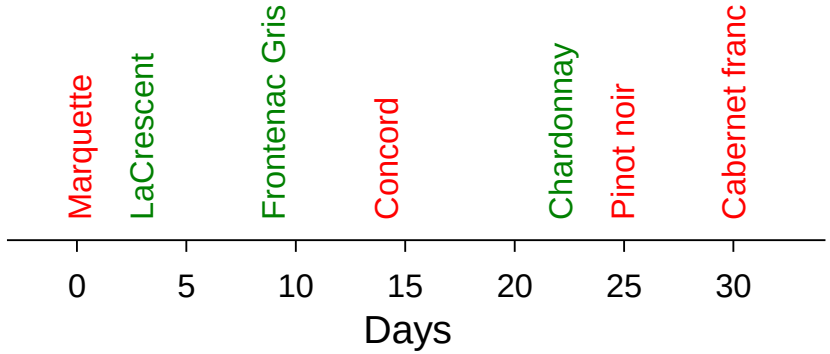
Spring of 2012

Impact on Marquette vines

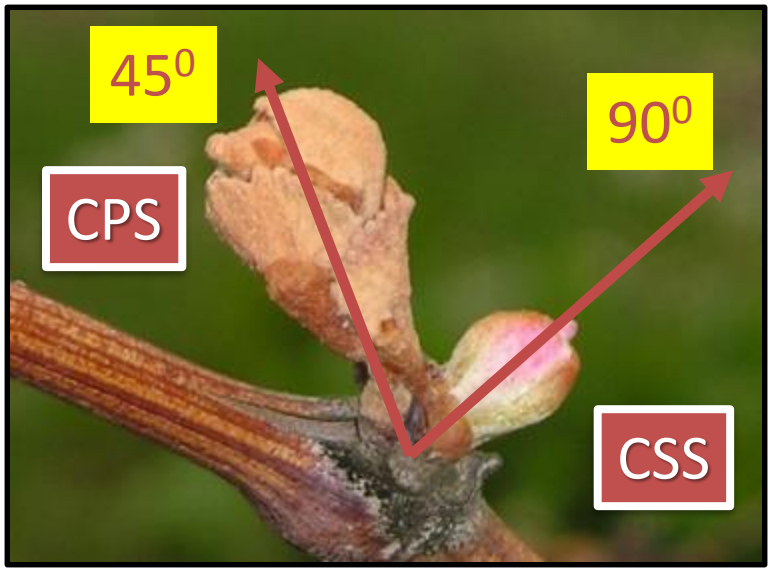


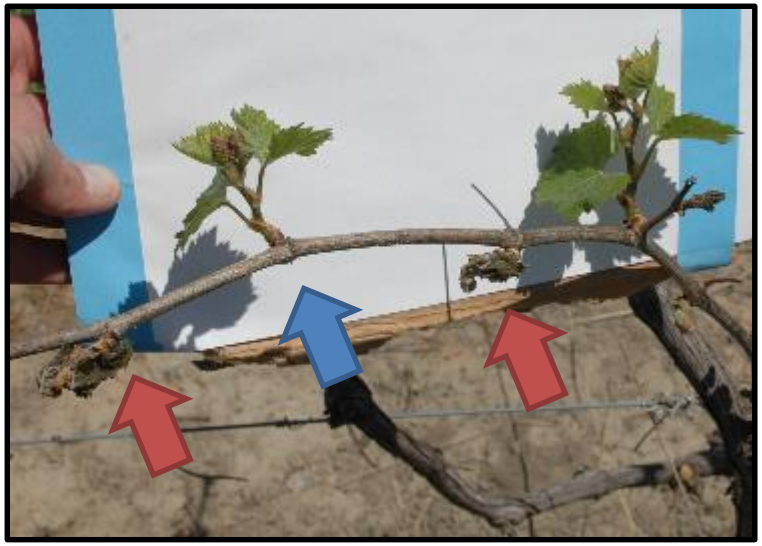


Relative budburst time in Michigan



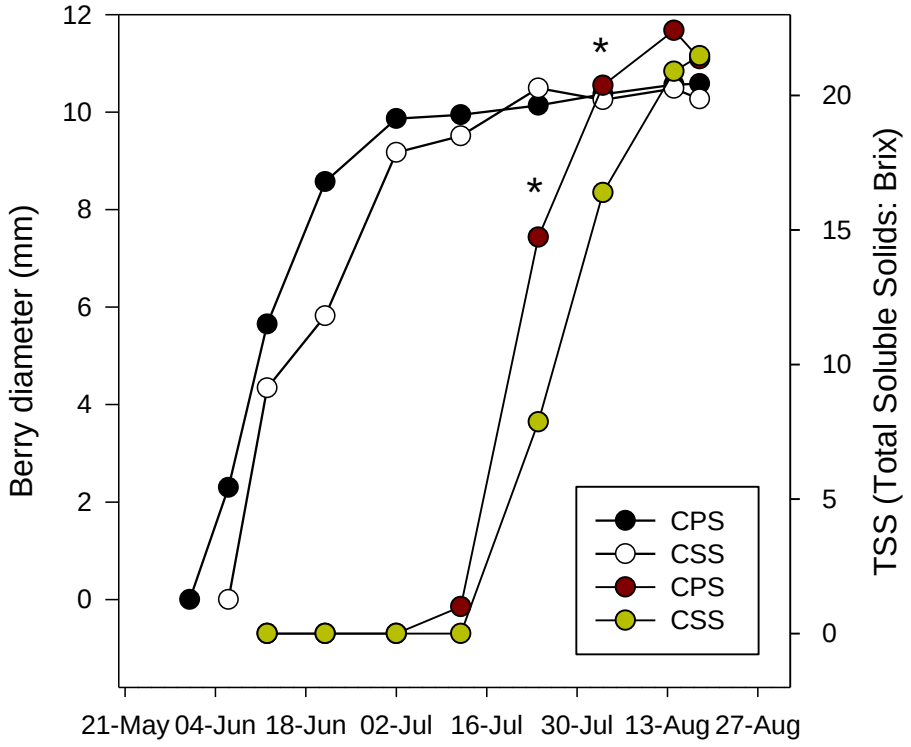
How the Vines Responded to the Frost

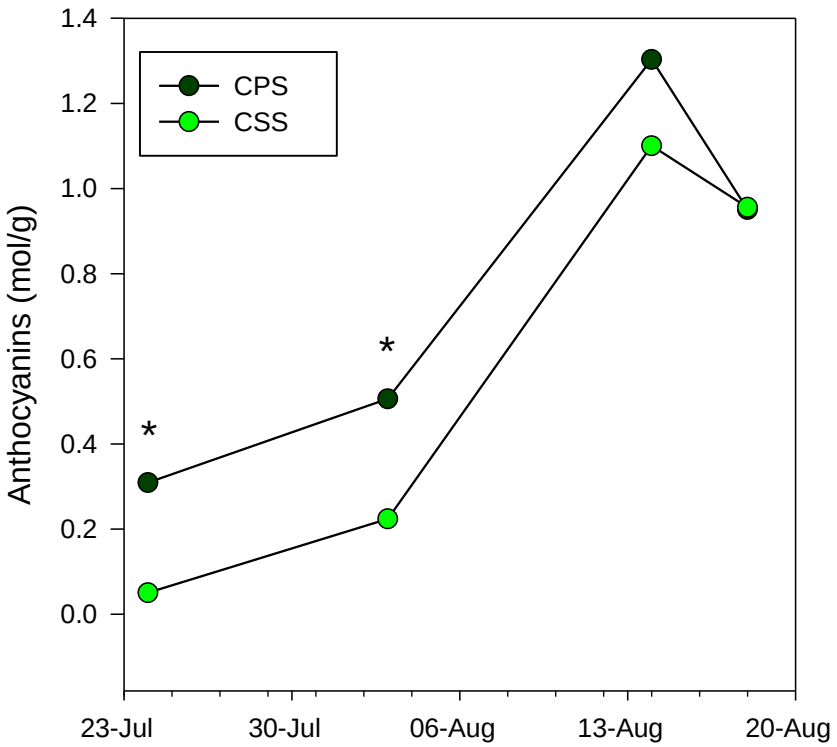




Impact of Frost: CPS *vs* CSS

No differences between training systems





No differences in berry growth; CSS recovered the late start (≈ 10d)

Difference in fruit chemistry only in the early phase of the ripening process

Yield Components and Fruit Quality

Trellis System	Yield (Kg/vine)	Number of clusters	Cluster weight (g)	Berries per cluster	Pruning weights (kg)	Ravaz Index
HWC	3.30	67	62.9	60	0.93	3.5
GDC	3.20	69	53.4	54	1.02	3.8
MT	3.53	75	58.0	62	1.12	3.8

Trellis System	TSS (°Brix)	pH	TA (g/L)	Phenolics (a.u./g)	Anthocyanin (mol/g)
HWC	19.5 b	3.4	9.2	0.90 b	0.91
GDC	21.4 a	3.3	9.4	1.05 a	0.92
MT	19.7 b	3.4	9.8	0.96 b	1.01

+10% at the time of harvest

+15% at the time of harvest

Conclusions 2012

- 2012 frost events similarly impacted the 3 training systems
- No differences in canopy growth and size (data not shown)
- Basic fruit chemistry of CPS and CSS was similar for all the training systems. Differences only due to late phenological stages at the beginning of fruit ripening.
- Yield per vine was similar between the training systems
- With 80% primary bud kill vines yielded about 2 T/acre
- Experimental wines made from CPS had more color, alcohol, acidity, astringency and body when compared with CSS wines (basic fruit chemistry at harvest different only for pH and TA)

Summary of the Work

Frioni T., Green A., Emling J.E., Zhuang S., Palliotti A., Sivilotti P., Falchi R. and P. Sabbatini. 2017. **Impact of spring freeze on yield, vine performance and fruit quality of Vitis interspecific hybrid Marquette**. Scientia Horticulturae, In Press.

Contents lists available at ScienceDirect

Scientia Horticulturae

journal homepage: www.elsevier.com/locate/scihorti

Experimental Activity in 2013-2016

- Experimental activities focused on:
  - Comparing training system
  - Modifying crop load
  - Canopy management strategies
- The objectives: study interaction between (a) canopy growth and yield levels (crop-load), (b) cluster exposure and (c) fruit technological maturity at harvest.

Comparing High Wire Cordon (HWC) Geneva Double Curtain (GDC) and Moving Trellis (MT)

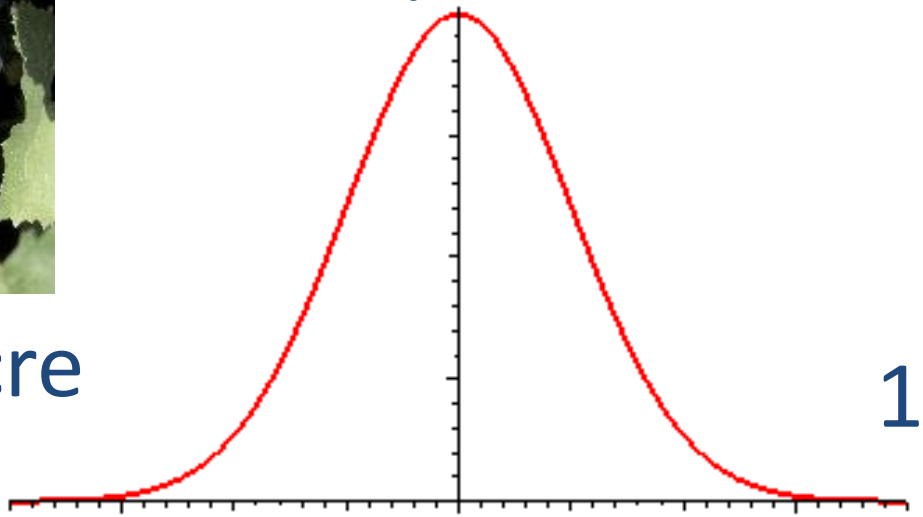
Trellis	Kg per vine	T/acre	Brix	pH	TA	Harvest Date
GDC	3.1a	6.3 a	24.8	3.5	7.0	Aug 30 to Sept 29
HWC	2.7 a	5.4 a	23.9	3.4	6.5	
MT	2.1 b	4.0 b	23.0	3.7	6.6	

- 2014 no significant data (Polar Vortex)
- The 3 training systems achieved optimal fruit quality at harvest
- Harvest date varied by a month between the experimental years
- MT produced less fruit without increasing fruit quality
- GDC and HWC performed similarly

Crop Load Experiments with HWC

5 T/acre

8 T/acre



YIELD PER VINE

10 T/acre

Treatment	Cluster/ vine	Cluster weight (g)	Berries / cluster	Berry weight (g)	Pruning Weight (kg)
High	264.0 a	52.6	44.2	1.19	1.85 b
Medium	184.8 b	49.6	42.0	1.18	1.97 b
Low	114.3 c	50.2	42.9	1.17	2.41 a

Yield Components and Fruit Chemistry

SWMREC: Southwest Michigan Research and Extension Center (Benton Harbor)

Treatment	TSS (°Brix)	pH	TA (g/L)	Phenolics (mg/L)	Anthocyanin (mg/L)
High	22.4 b	3.6 b	6.70	1264 b	916 c
Medium	22.9 b	3.6 ab	6.93	1594 a	985 b
Low	25.8 a	3.8 a	6.78	1668 a	1024 a

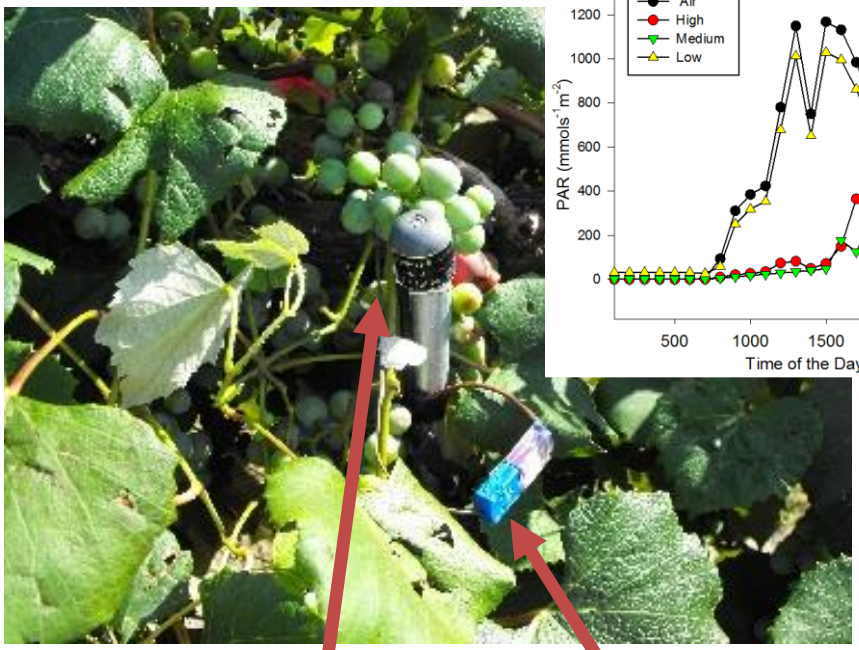
- Impact on TSS (Brix) of +10/20% with a reduction of yield of -40/50%
- Minimal impact on pH at Acidity
- Reduction on phenolic compound in high cropping level (-25%)
- Impact of cropping levels on color compounds

Increasing Color Compounds and Sugar Accumulation

- Canopy management
  - Leaf removal pre-veraison
  - Cluster exposure 100%
- Time of harvest
  - Targeting 24 Brix in all the cropping treatments

Improving Cluster Microclimate

Environmental parameters



PAR

Photosynthetic Active Radiation

Temperature

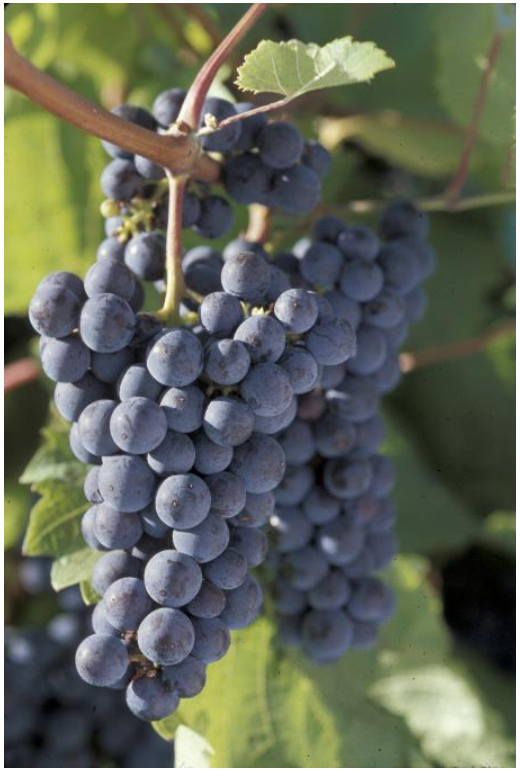
Cluster Exposure at Pre-Veraison

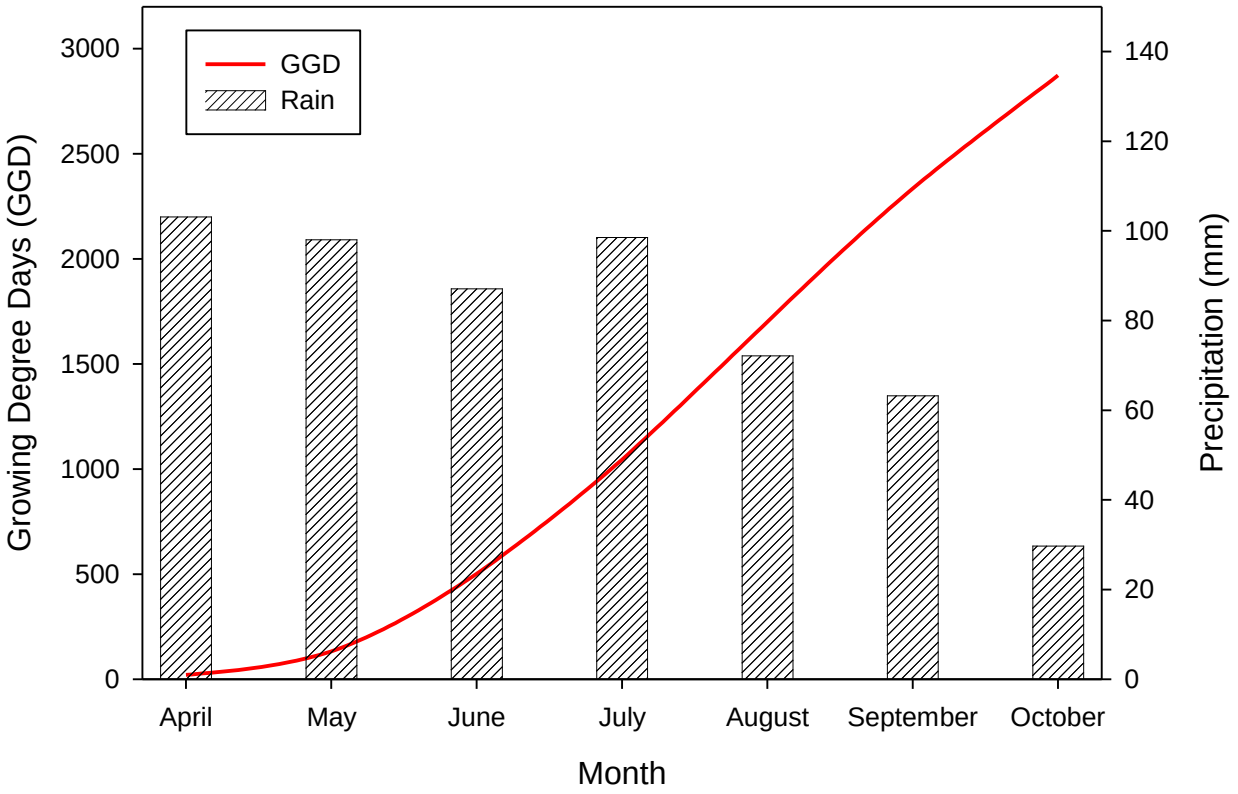
Treatment	Cluster exposure	Brix	pH	TA	Anthocyanin (mg/L)
High	No	21.9 c	3.5	6.9 a	797 b
	Yes	23.8 b	3.4	6.5 b	1045 a
Medium	No	23.6 b	3.3	6.8 a	916 b
	Yes	24.3 ab	3.4	6.3 b	1200 a
Low	No	23.7 b	3.4	6.8 a	1024 a
	Yes	25.5 a	3.5	5.5 b	1222 a

- Clear trend of cluster exposure in improving sugar accumulation
- Clear trend of cluster exposure in reducing acidity accumulation
- Clear trend of cluster exposure in improving color compounds: high crop load with leaf removal has the same concentration of anthocyanins of medium and low cropping levels without cluster exposure

Managing Harvest Date (2015)

Targeting 24 Brix





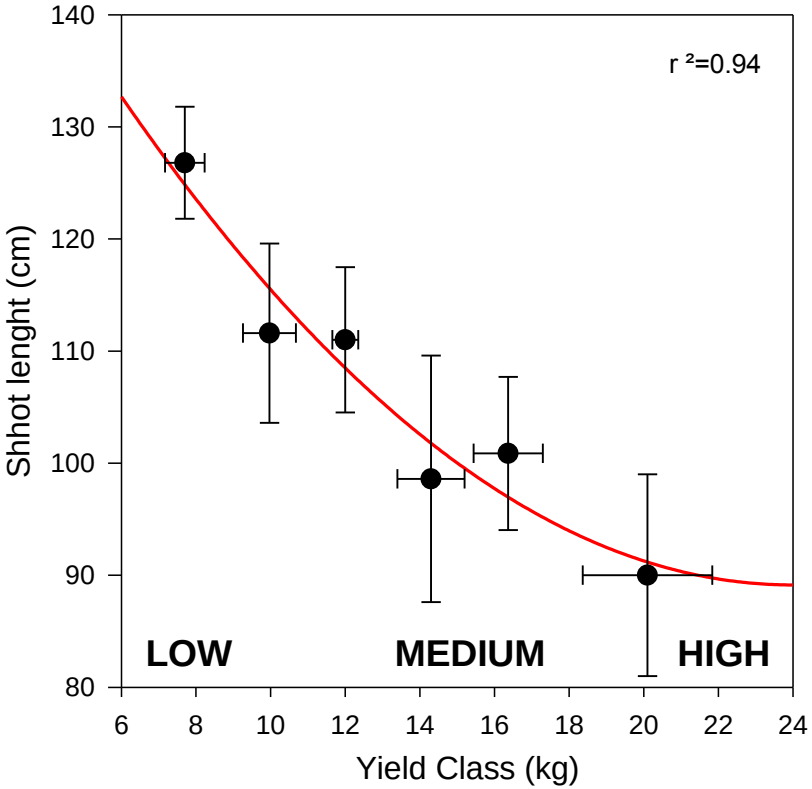
Managing Harvest Date (2015)
Targeting 24 Brix

Treatment	Harvest Date	Yield (T/acre)	TSS (°Brix)	pH	TA (g/L)	Phenolics (mg/L)	Anthocyanin (mg/L)
High	Sept 29	10.2 a	23.9	3.6	7.0	1718	1385
Medium	Sept 24	8.5 b	24.6	3.6	6.9	1777	1141
Low	Sept 17	5.3 c	24.8	3.5	6.7	1837	1322

- Difference of about 2 weeks between Low and Medium cropping levels harvest date
- All the treatments reached 24 Brix in 2015
- No differences in other fruit technological maturity parameters

Potential Problems For future Research

Sustainability



Cold Hardiness

Conclusions: What We Learn in Michigan

- Marquette is very prone to frost
  - Great production on secondary, no difference in basic fruit quality from CPS and CSS
- Marquette ripens the fruit very early for MI standards
  - End of August / Early September: at least 20-40 days before our signature red vinifera CVs (Pinot Noir and Cabernet Franc)
- Marquette is resilient to cropping levels
  - Yield per vine barely impacted basic fruit chemistry fruit technological maturity at harvest
  - Canopy management improved fruit technological maturity at harvest
  - Harvest time is pivotal to reach desired fruit maturity

Questions?