Challenges for Future Cool Climate Winegrape Production Using Current and "New" Cultivars and Novel Cultural Approaches

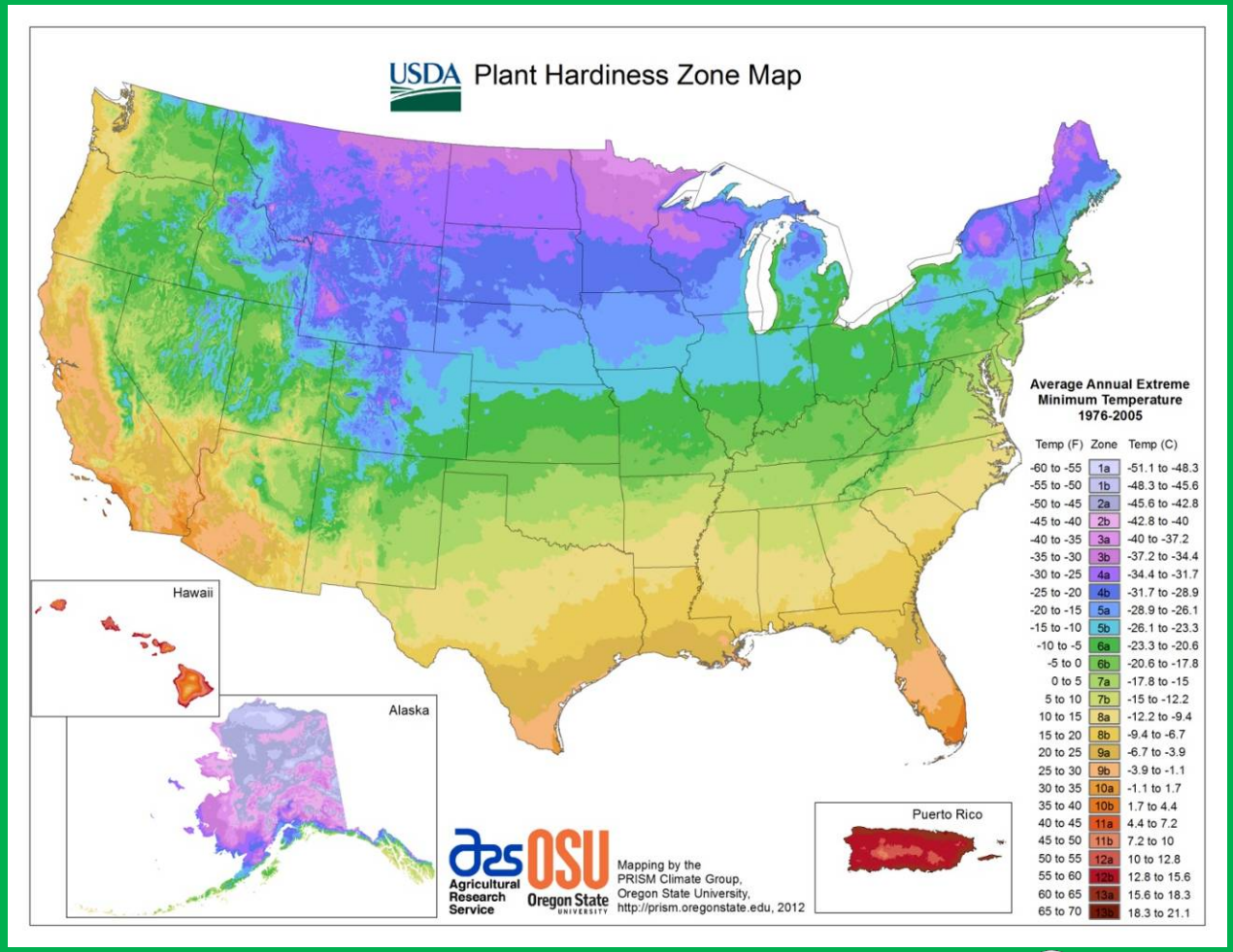
Dr. G. Stanley Howell, Professor Emeritus of Viticulture
Dr. Paolo Sabbatini, Assistant Professor of Viticulture
Department of Horticulture, Michigan State University
and
Dr. James A. Wolpert, Extension Viticulturist
UC-Davis

What are the Challenges?

- Seasonal Variability
- a) Growing Degree Days
- b) Growing Season Length
- c) Precipitation – How much, and when?
- d) Winter cold
- e) Frost damage

Expansion in Cold Winters

From 4a (-30F, -34C) to 7b (0F, -15C)



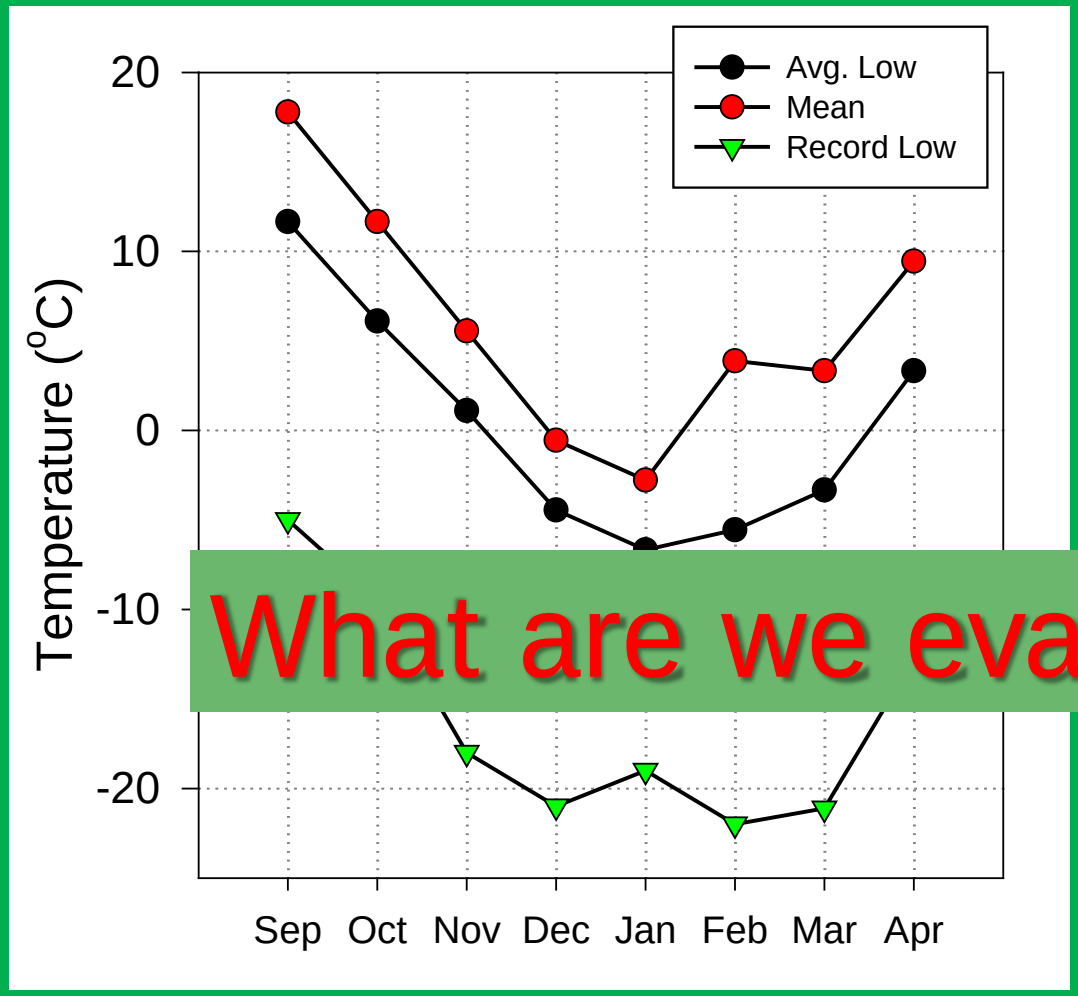
The problems

Cold injury

Cool Climate

Winter Temperatures

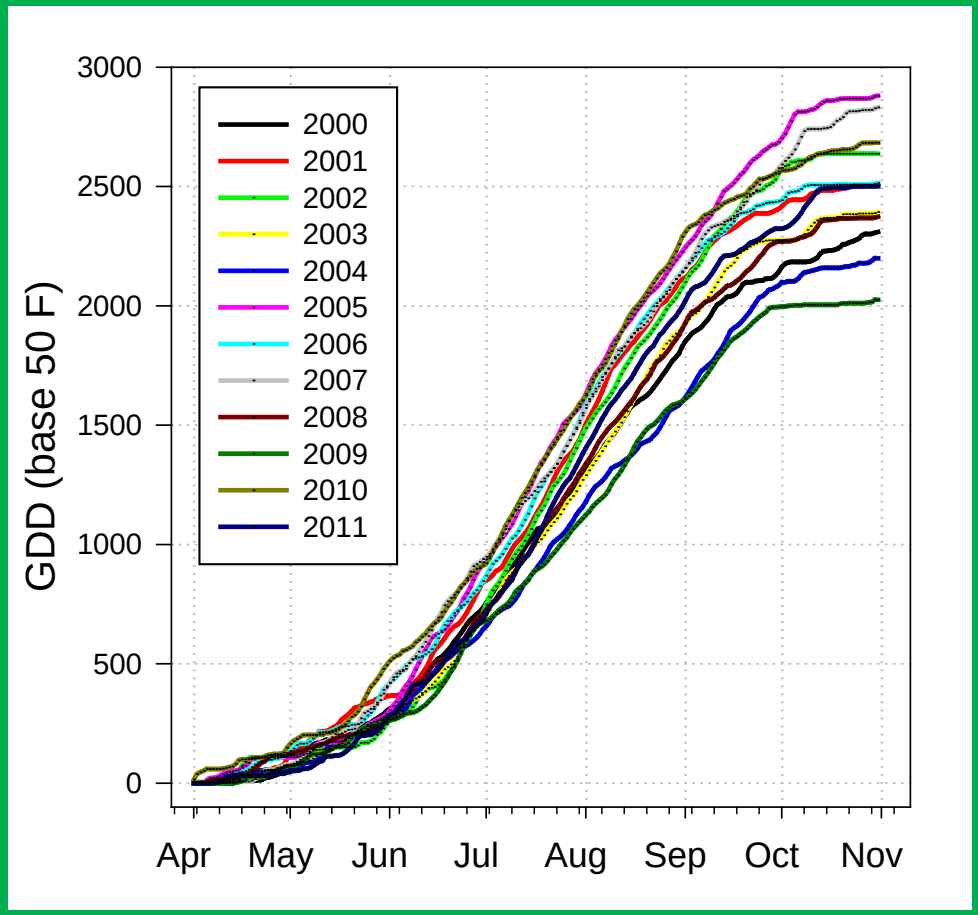
Michigan example



What are we evaluating for?

Weather Variability

Michigan example

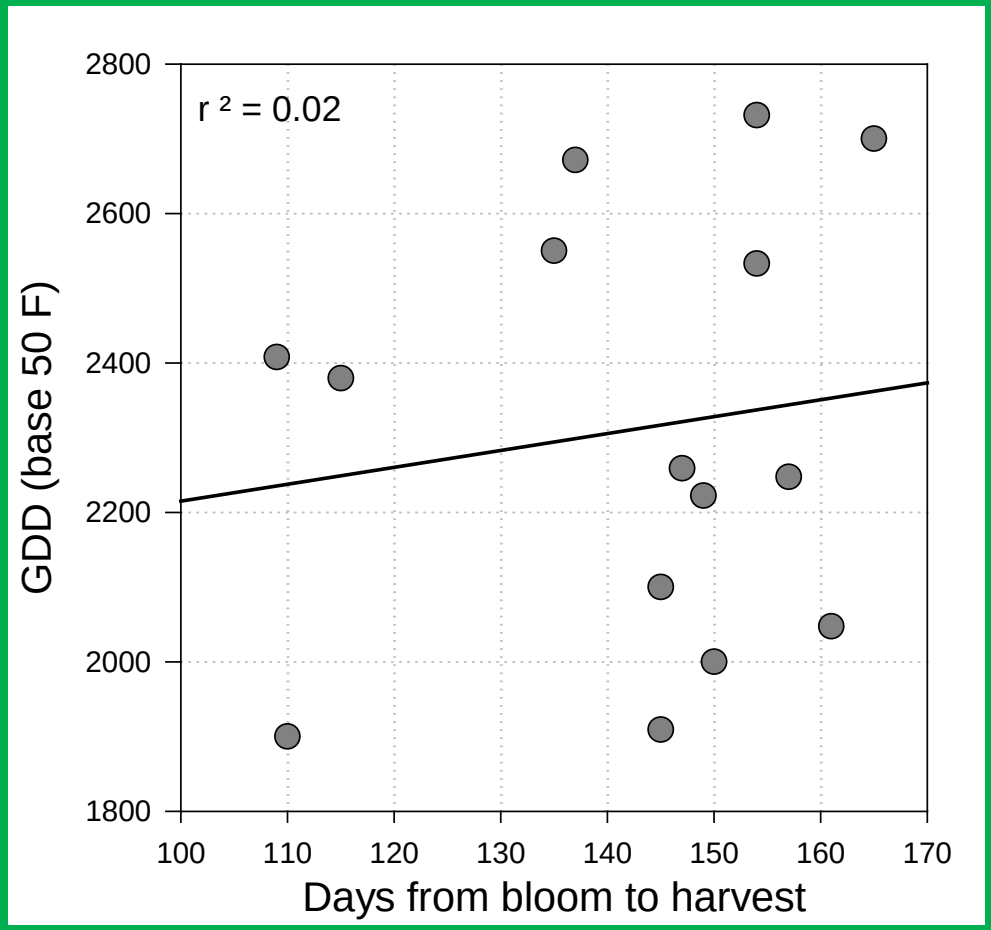


- **Max 2010 = 2683 GDD**
- **Min 2009 = 2025 GDD**

GDD (Growing Degree Days or heat units, calculated with base 10 °C from April 1st, as reported by Baskerville and Emin (1969)

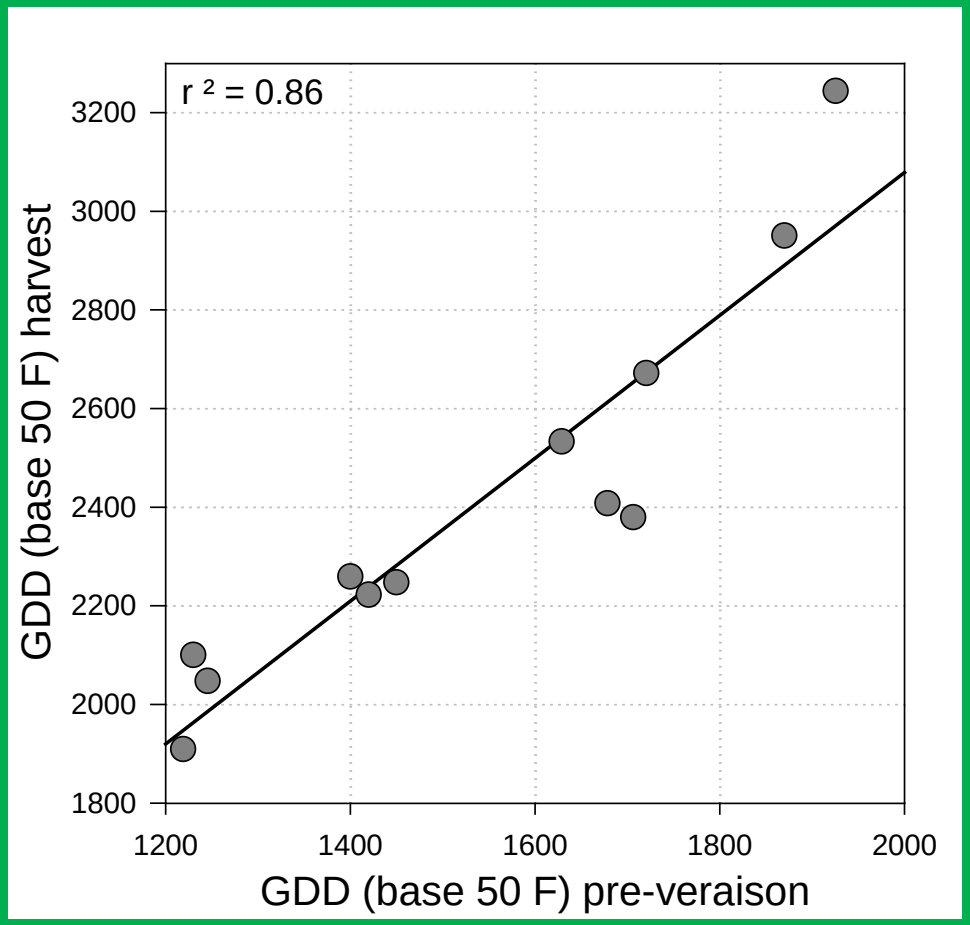
GDD and Growing Season Length

Michigan example



Flexible Viticulture Options

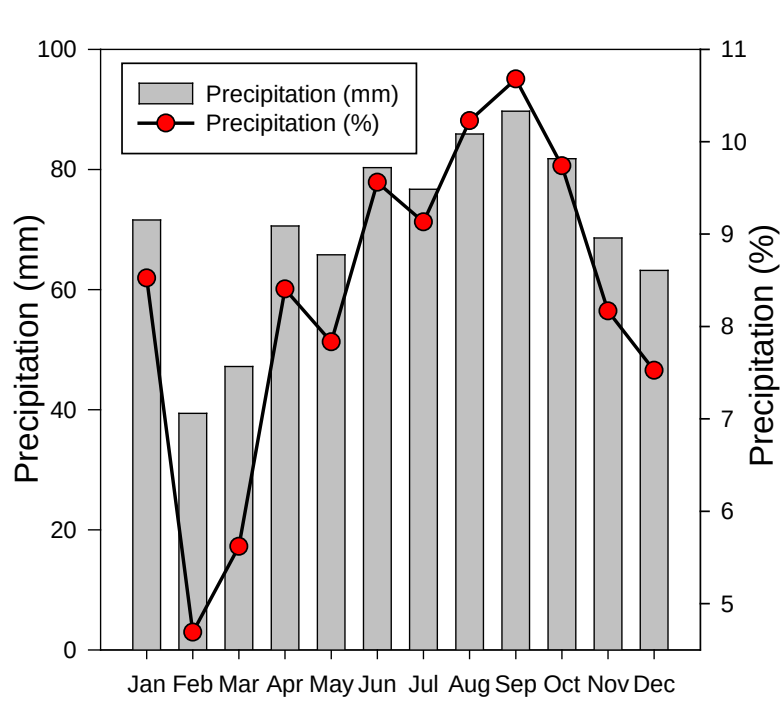
Michigan example



Another Problem in the East

Michigan example

- The varieties that are cold resistant and early ripening for cool climate viticulture, are highly sensitive to fruit rot!

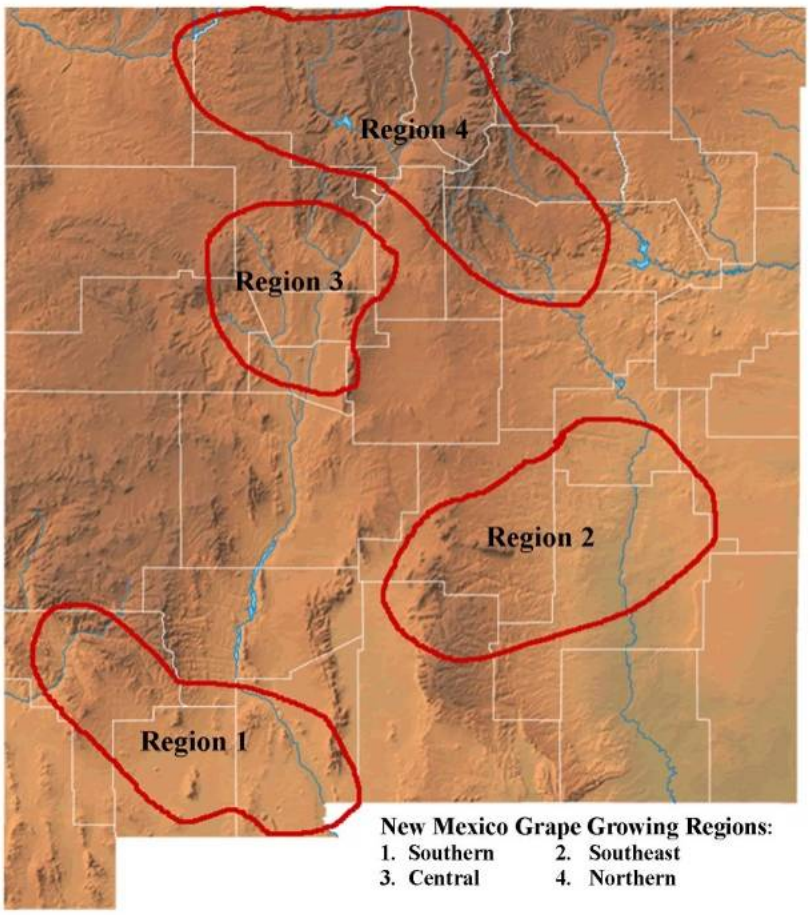


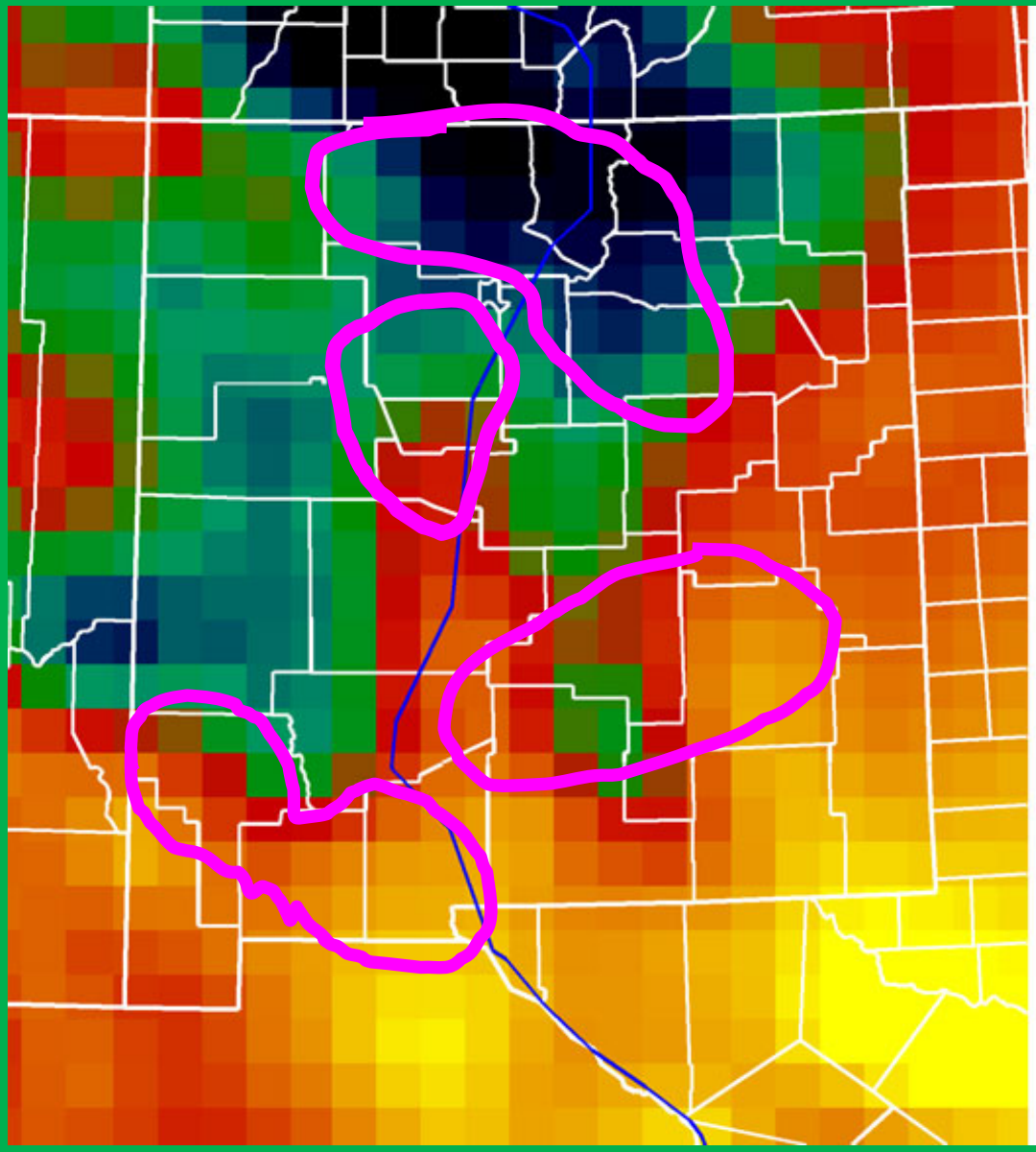
Average GDD (Base 50F)

- Michigan
- NW – 1500-2500
- SW – 1800-3300
- MI is a cold winter/cool summer climate

- New Mexico – 4000-5000
- NM is a cold winter/hot summer climate

Growing Regions in NM

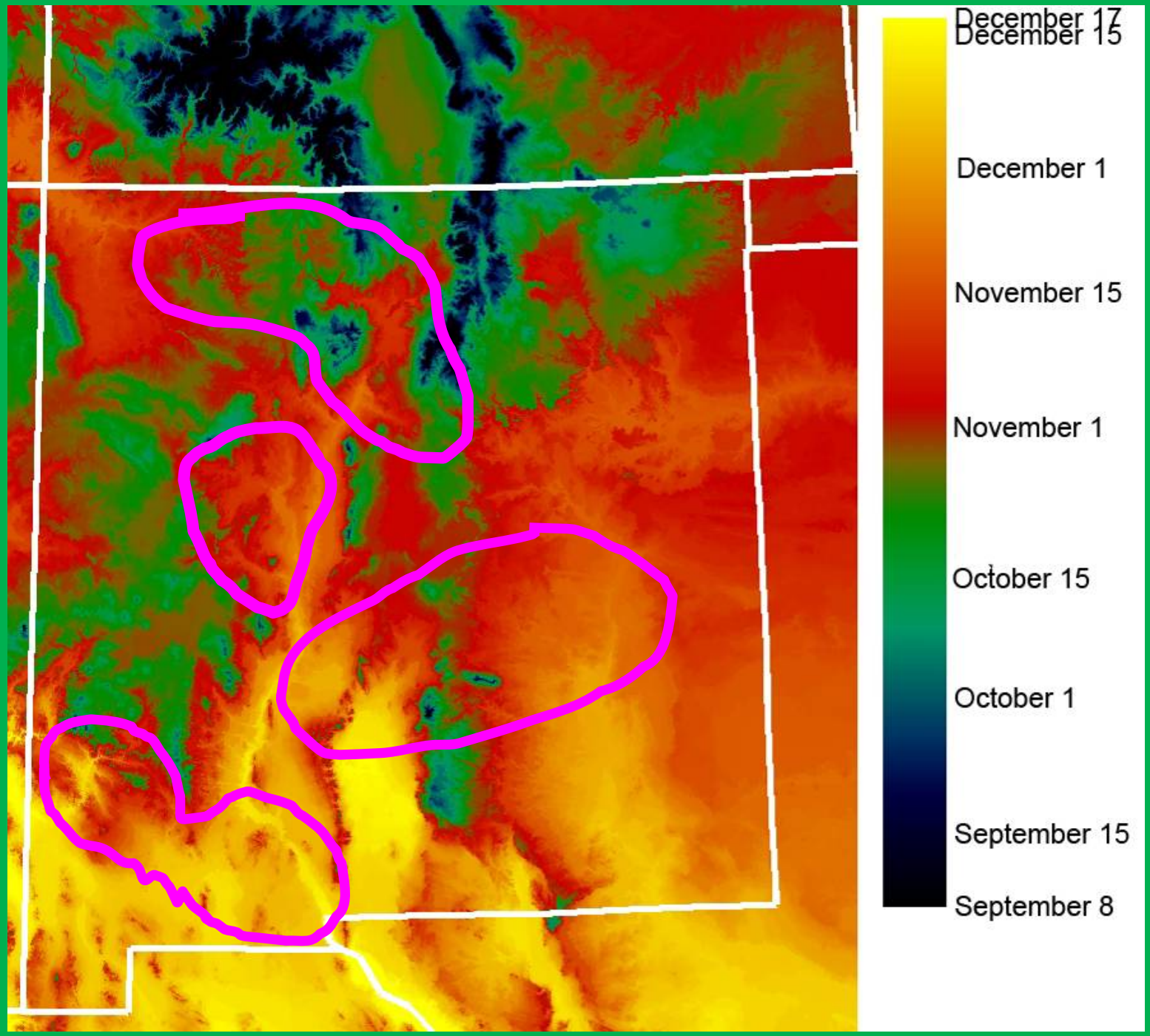




VITICULTURE & ENOLOGY

Growing Season Length

- Michigan 150-180 days
- New Mexico < 150, 150-180
- Similar except for region north of Santa Fe



VITICULTURE & ENOLOGY

Precipitation

- Michigan -- ~36-38”
- New Mexico -- ~ 10-15”
- Significant difference especially as MI gets frequent rains post-veraison with negative fruit quality impacts

Winter Cold and Spring Frost

Why a variety trial?

Michigan Grape Industry: is One of the Most Unique Viticulture in the World

- Native, Hybrid, Vinifera, Super Hardy varieties

Concord
Vitis labrusca

Vignoles
Hybrid

Pinot blanc
Vitis vinifera

Frontenac
Vitis riparia based

Viticulture
MICHIGAN STATE
UNIVERSITY

Zabadal T., Sabbatini P., Elsner D., 2008. Wine Grape Varieties for Michigan and Other Cold Climate Viticultural Regions. MSU Extension Bulletin CD-007

Expanding industry: planting what?

USDA 2011 report

Variety Category	1997		2000		2003		2006		2011	
	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%
Concord	9100	73	9200	68	9530	66	9350	64	9030	60
Niagara	2350	19	3000	22	3450	24	3520	24	3480	23
Hybrids	580	5	660	5	580	4	630	4	725	5
Viniferas	470	4	640	5	840	6	1100	8	1765	12
Total	12,500		13,500		14,400		14,600		15,000	

+20%

Wine grapes: 2490 acres + 230%

Vinifera: 1765 acres + 370%

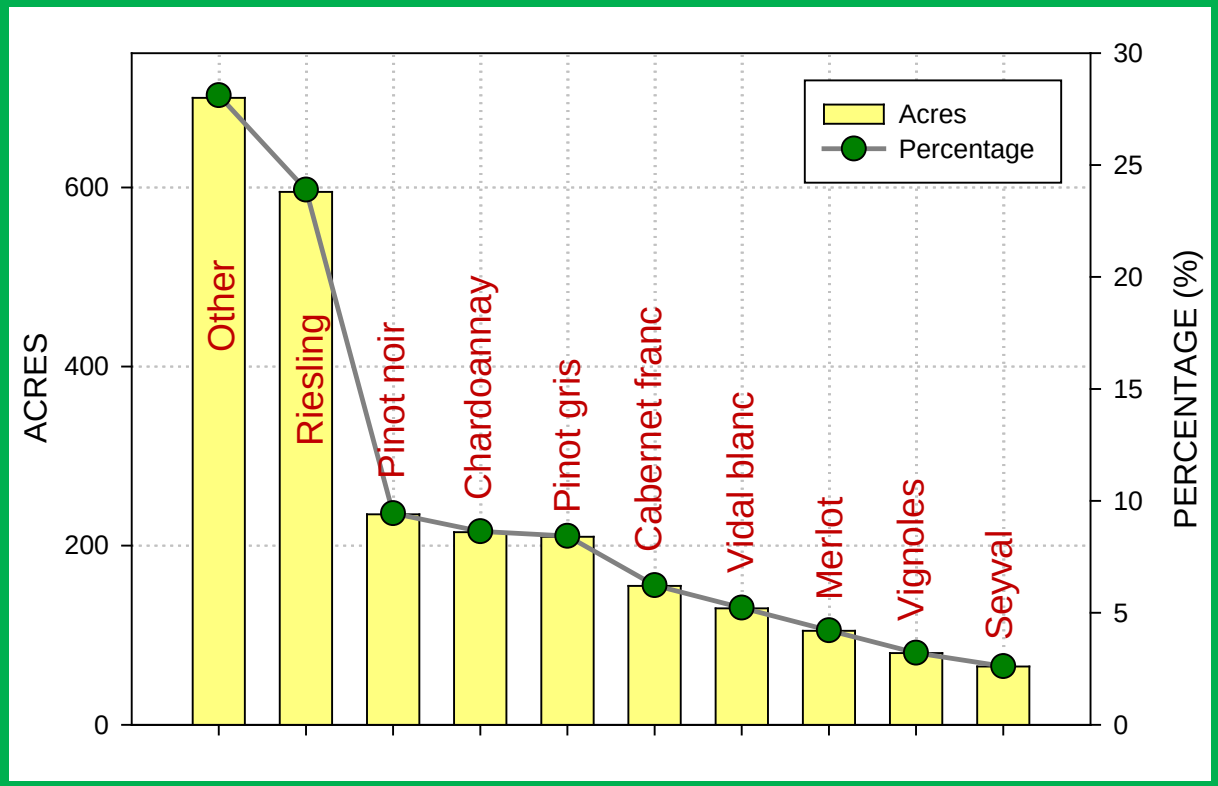
Michigan AVAs

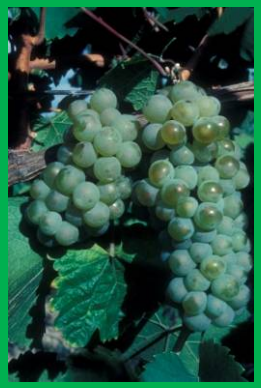
Wine grape acreage

	2006 Acres	2011 Acres	Percentage (%)	Increase (%)
NW	1040	1450	53%	+40%
SW	855	990	36%	+16%
WCE	230	300	11%	+24%
Total	***2125***	***2740***		***+22%***

Top 10 wine grape varieties

Why a variety trial?





Riesling

Pinot noir

Top 5 Wine Grape Varieties in AVAs

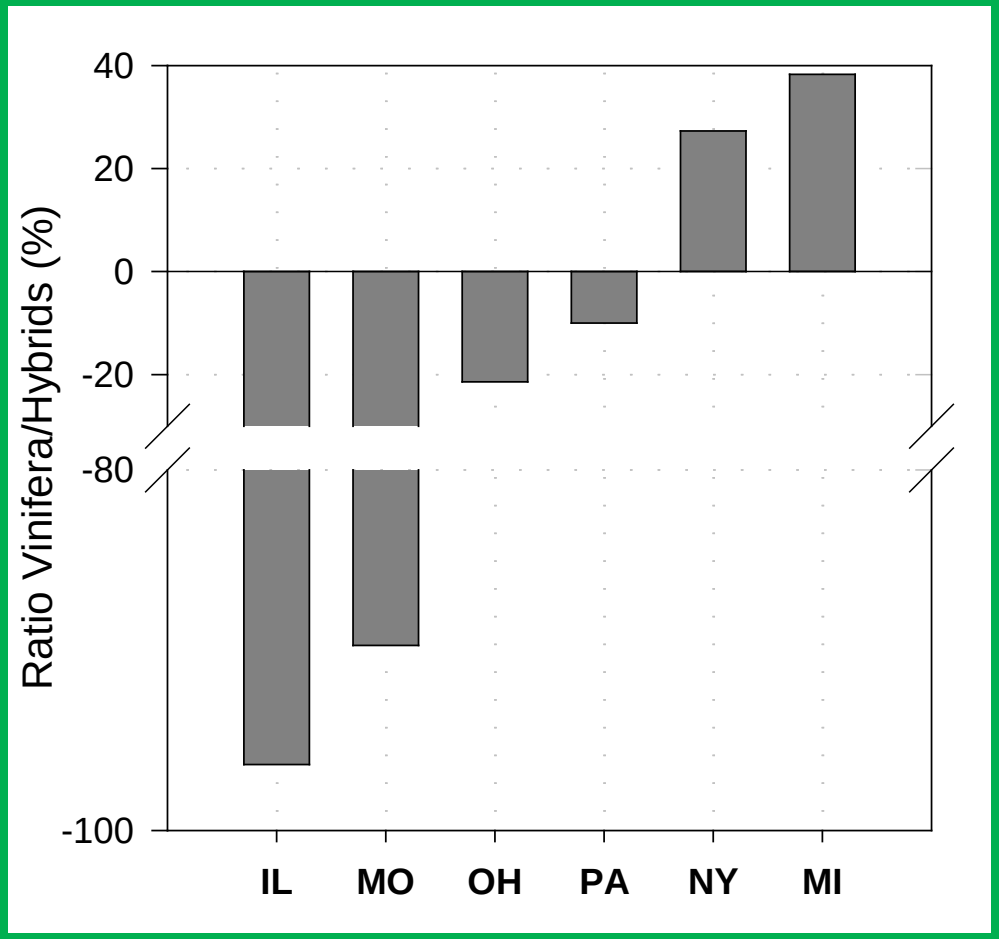
NW	ACRES	% on total acres	SW	ACRES	% on total acres
Riesling	485	*82%*	Vidal Blanc	125	*96%*
Pinot Noir	196	*83%*	Riesling	100	*17%*
Chardonnay	165	*77%*	Cabernet F.	55	*35%*
Pinot Gris	155	*74%*	Pinot Gris	53	*25%*
Cabernet F.	92	*59%*	Seyval	47	*72%*

NW 70% whites and 30% reds

NW 5 times more reds than SW

Ratio between Vinifera/Hybrid

75% of Acreage *American* Varieties in the East of US



A critical Question is Always Which Variety to Plant for a Young Developing Industry

Research perspective

Grower perspective

Consumer perspective

Winery perspective

Varieties planted

50% white and 50 % red

40% hybrids and 60% vinifera

Southwest

Mandatory Core

Merlot, Cabernet Sauv

Hybrid

Brianna, Chardonel, GR7, Marquette, Noiret, NY760844.24, Phoenix, Regent, Traminette, Valvin Muscat, Valvin Muscat

Vinifera

Albarino, Barbera, Dolcetto, GM318, Gruener Veltliner, Lagrein, Marsanne, Merlot, Petite Sirah, Rousanne, Sauv. Gris, Sauv. Bl. Musque, Sauv. Blanc, Semillon, Tempranillo, Teroldego, Tocai Fruilano, Muscat Blanc

Northwest

Mandatory Core

Pinot noir, Cabernet Franc

Hybrid

Brianna, Chambourcin, Corot Noir, Frontenac, La Crescent, Noiret, NY76.0844.24, NY81.0315.17, St. Croix, Vidal

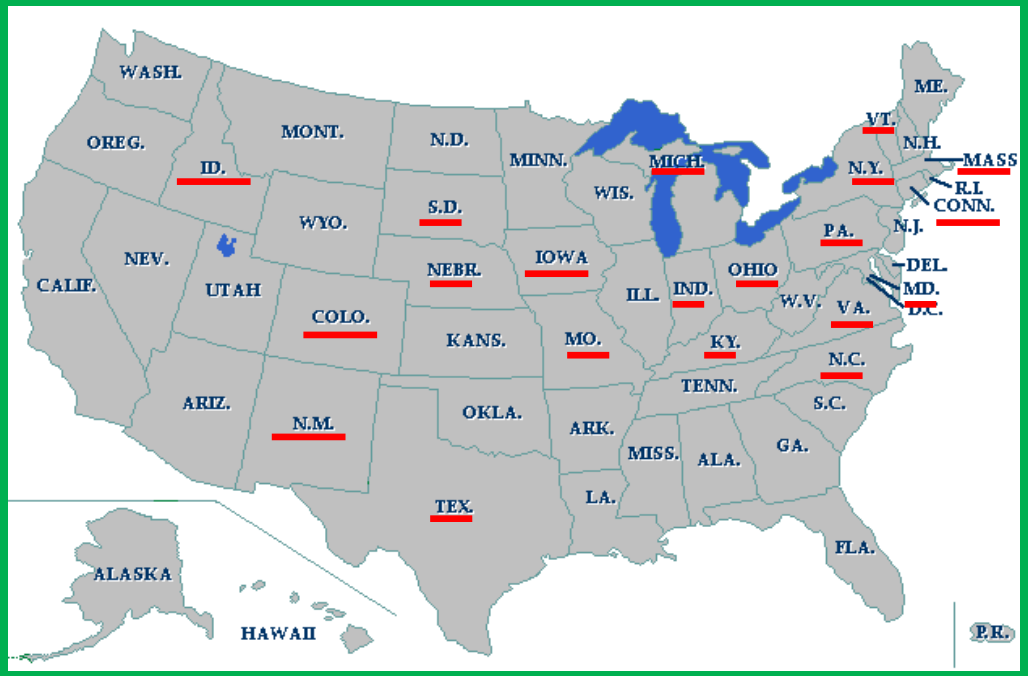
Vinifera

Albarino, Cinsault, Dornfelder, Gruner Veltliner, Lagrein, Rkatsiteli, Semillon Teroldego, Tocai Friulano, Zweigelt

Data collection

- Planting density 8’-10’ x 4’-6’
- Rootstock is 101-14
- Irrigation
- VSP training system 4-5 shoot per foot of canopy
- Best management practices for local differences
- Vine growth and phenology
- Fruit chemistry
- Micro-vinification (*Spartan Cellar and private wineries*)

NE1020 project: Coordinated Wine Grape Variety Evaluations in the Eastern USA



- 2006: Project started
- 2007: Vine order (NovaVine and Double-A nursery)
- 2008: Planting and unitial data collection
- 2009: Data collection, including wine-making
- 2010-2016: Data collection and analysis, wine evaluations
- 2012-2018: Continuous reporting to stakeholders of preliminary and final evaluation results

Current Important New Mexico Winegrape Cultivars

- List in order of # Vineyards planting CV (>10)
- Chardonnay
- Cabernet Sauvignon
- Riesling
- Vidal blanc
- Syrah/Shiraz
- Merlot
- Cabernet Franc
- Baco Noir
- Gewurztraminer
- Pinot noir
- Muscat Canelli
- Sangiovese

Cultivars Currently Under Trial in New Mexico

- Gewurztraminer
- Cabernet Sauvignon
- Montepulciano
- Malbec
- Carignane
- Zweigelt
- Tannat
- Cinsault
- Gruner Veltliner
- Alberino
- Picpoul Blanc
- Durif (Petite Sirah)
- Negroamaro
- Teroldego
- Calzin
- Petit Verdot
- Cabernet Franc
- Carmenere
- Tocai Friuliano

Potential Alternative Varieties

Cool Climate	Warm Climate
Hybrids	Hybrids
Chambourcin, Marquette Chardonel, Traminette, Valvin musquat, Frontenac gris	Chambourcin, Regent
Vinifera	Vinifera
Dolcetto, Barbera, Teroldego, Lagrein	Montepulciano, Nero d'Avola, Barbera, Tempranillo, Albarino, Verdejo, Verdello, Vermentino, Verdicchio

Current Fads Traditional Wine Drinkers and "Millennium" Drinkers

- Traditional – C. Sauvignon, Merlot, Zinfandel, P. noir, Petite Sirah,
- Millennium – Off-dry to sweet, fruity, especially muscat CVs. Attracted to clever lables

Preliminary recommendations in Michigan



Cool-cold climate vinifera cultivars		
Core	Emerging from private and MSU evaluation in the NW and SW	Evaluated and not suggested
Cabernet franc Chardonnay Gamey noir Gewürztraminer Merlot Pinot gris Pinot noir Riesling Pinot blanc	Dornfelder Gruner Veltliner Lagrein Rkatsiteli Teroldego Tocai Friulano Zweigelt Sauvignon Gris Sauvignon Blanc Musque	Albariño Cinsaut Feher Szagos Madeline Angevine Moscato Canelli Moscato Giallo Muscadella du Bordelais Muscat Ottonel Fiano Orange Muscat Semillon Siegerrebe Touriga National

U.S. Wines

- 10 varieties comprise about 80% of all bottled varietal wine:
  - *Chardonnay, Cabernet Sauvignon, Merlot, Zinfandel (incl White Zin), Sauvignon blanc, Pinot noir, Pinot gris/grigio, Syrah/Shiraz, Petite Sirah, Viognier*
- First three are often referred to as the "International Varieties"

Activities in Warm Climate: CA

Cultivars and clone	Source
Aglianico -03	VCR 2 Rauscedo, Italy
Carmenere -02	VCR 702 Rauscedo, Italy
Cabernet Sauvignon -08	#102, Concannon, CA
Cinsaut -02	Black Malvoisie FPS 02, Sonoma, CA
Durif -03	Petite Sirah FPS 03
Freisa -01	Jackson, CA
Grenache noir -515	ENTAV-INRA® 515, (ENTAV, France)
Malbec -06	VEN, UC Davis, syn=Cot
Montepulciano -02	VCR 10 Rauscedo, Italy
Petit Verdot -400	ENTAV-INRA® 400 (ENTAV, France)
Refosco -03	VCR 5 Rauscedo, Italy
Souzao -01	VEN, UC Davis
Syrah -07	France 877
Tannat -474	ENTAV-INRA® 474 (ENTAV, France)
Tempranillo -02	AGRO, Spain
Tinta Amarella -01	Jackson, CA
Tinta Francisca -01	Portugal
Tinta Madeira 01	Lodi, CA
Tinto Cao -04	Jackson, CA
Touriga Nacional -02	Portugal, 1981

Activities in Warm Climate: CA

Cultivars and clone	Source
Aglianico -03	VCR 2 Rauscedo, Italy
Carmenere -02	VCR 702 Rauscedo, Italy
Cabernet Sauvignon -08	#102, Concannon, CA
Cinsaut -02	Black Malvoisie FPS 02, Sonoma, CA
Durif -03	Petite Sirah FPS 03
Freisa -01	Jackson, CA
Grenache noir -515	ENTAV-INRA® 515, (ENTAV, France)
Malbec -06	VEN, UC Davis, syn=Cot
Montepulciano -02	VCR 10 Rauscedo, Italy
Petit Verdot -400	ENTAV-INRA® 400 (ENTAV, France)
Refosco -03	VCR 5 Rauscedo, Italy
Souzao -01	VEN, UC Davis
Syrah -07	France 877
Tannat -474	ENTAV-INRA® 474 (ENTAV, France)
Tempranillo -02	AGRO, Spain
Tinta Amarella -01	Jackson, CA
Tinta Francisca -01	Portugal
Tinta Madeira 01	Lodi, CA
Tinto Cao -04	Jackson, CA
Touriga Nacional -02	Portugal, 1981

"new" varieties

standards

"new" selections

Activities in Warm Climate: CA

Recommended Varieties

Petite Sirah - Durif
Malbec (if better yielding clone)
Petite Verdot
Tannat

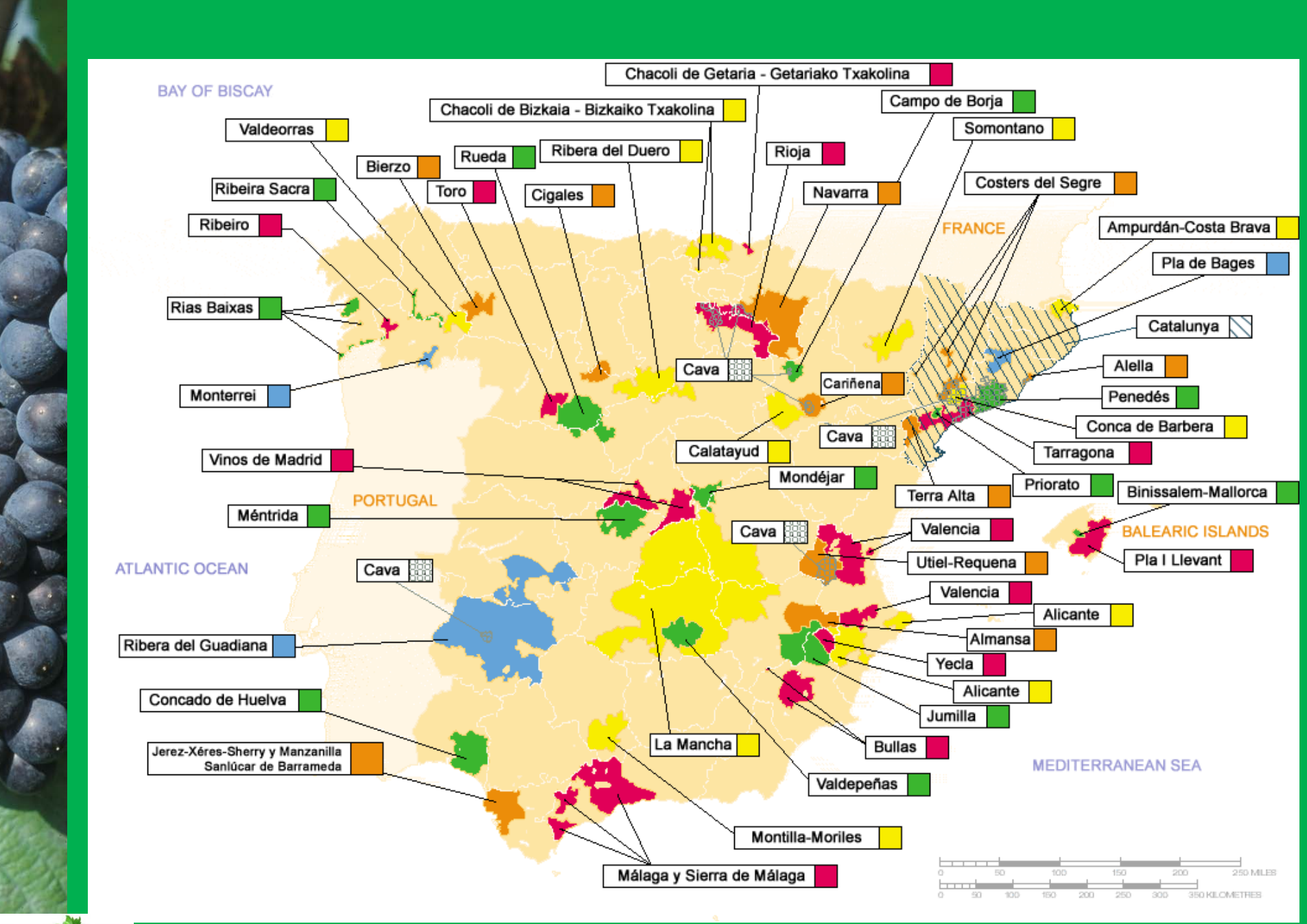
New Trial at Kearney: 55 Varieties

Red Varieties

Arinarnoa
Bonarda
Caladoc
Carmenere
Ciliegiolo
Corvina Veronese
Counoise
Donzillinho
Ederena
Garnacha Tinta
Graciano
Juan Garcia
Mammolo
Marselan
Morrastel
Mourisco da Semente
Nielluccio
Periquita
Pinotage
Plavina
Prieto Picudo
Rondinella
Sagrantino
Schioppettino
Segalin
Semebat
Trincadeira Preta
Vespolina

White Varieties

Albillo Mayor
Albillo Real
Alvarinho
Arinto
Arneis
Bianchetta Trevigiana
Biancu Gentile
Biancolella
Coda di Volpe
Cortese
Erbaluce
Falanghina
Fiano
Forastera
Greco di Tufo
Malvasia Bianca
Marsanne
Moscato Giallo
Parellada
Perera
Petit Manseng
Picolit
Ribolla Gialla
Roussanne
Tocai Friulano
Trebbiano Toscano
Viozinho

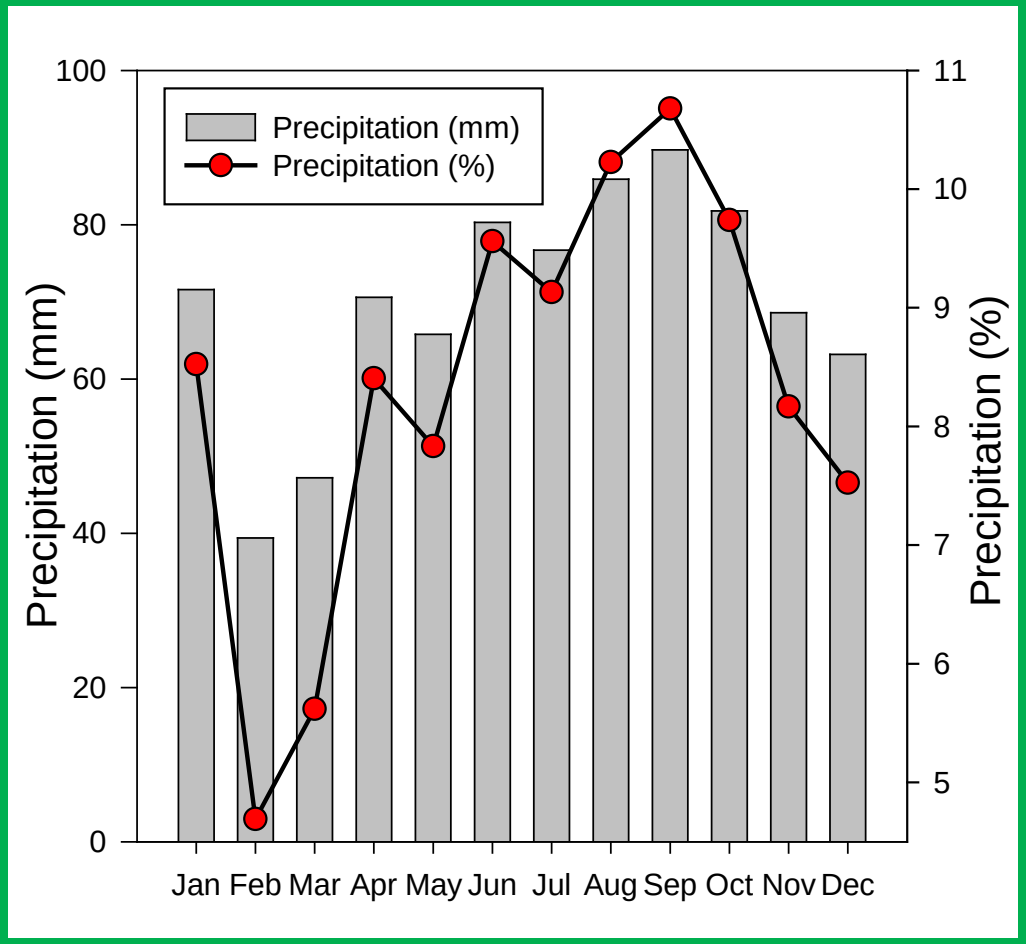

BAY OF BISCAY
Chacoli de Getaria - Getariako Txakolina
Chacoli de Bizkaia - Bizkaiko Txakolina
Campo de Borja
Somontano
Valdeorras
Rueda
Ribera del Duero
Rioja
Bierzo
Toro
Cigales
Navarra
Costers del Segre
Ribeira Sacra
Ribeiro
FRANCE
Ampurdán-Costa Brava
Pla de Bages
Rias Baixas
Catalunya
Cava
Alella
Cariñena
Monterrei
Penedés
Cava
Conca de Barbera
Calatayud
Tarragona
Vinos de Madrid
Mondéjar
Priorato
Terra Alta
Binissalem-Mallorca
PORTUGAL
Méntrida
Cava
Valencia
BALEARIC ISLANDS
Utiel-Requena
Pla I Llevant
ATLANTIC OCEAN
Cava
Valencia
Alicante
Ribera del Guadiana
Almansa
Yecla
Concado de Huelva
Alicante
Jumilla
La Mancha
Bullas
Jerez-Xéres-Sherry y Manzanilla
Sanlúcar de Barrameda
MEDITERRANEAN SEA
Valdepeñas
Montilla-Moriles
Málaga y Sierra de Málaga
0 50 100 150 200 250 MILES
0 50 100 150 200 250 300 350 KILOMETRES

Cool Climate Varieties & Rot

- Fruit rot is a Major Problem (with Cold Hardiness) Limiting Vinifera Growing in the Great Lakes Region.

The Problem

Varieties that are cold resistant and early ripening for cool climate viticulture, are highly sensitive to fruit rot!



The “compactness” Issue

Chardonnay

Gewurztraminer

Pinot blanc

Pinot gris

Riesling

Pinot noir

Aim of the Experiments

- To determine whether a quantified amount of leaf removal at bloom would reduce fruit-set and achieve a controlled reduction in (1) cluster compactness and (2) yield per vine

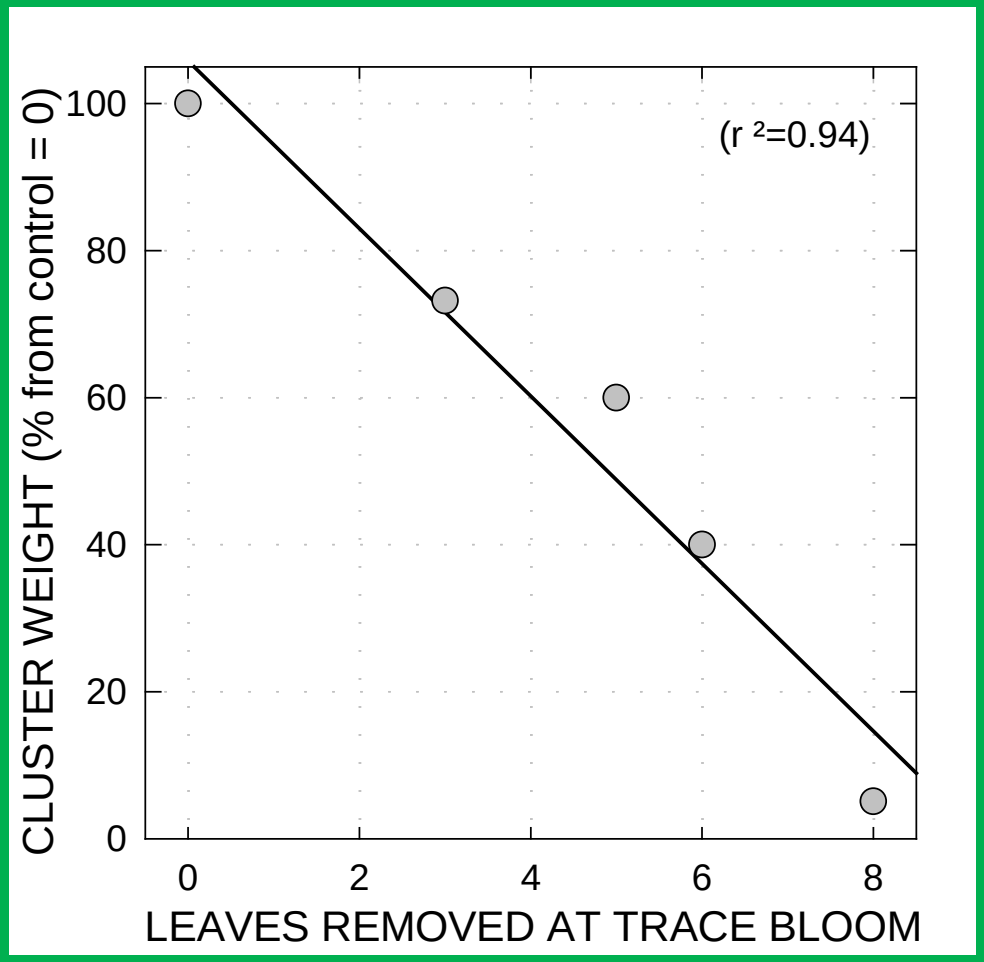
VEREP Viticulture and Enology Research and Extension Program

Viticulture MICHIGAN STATE UNIVERSITY

MICHIGAN STATE UNIVERSITY

The Hybrid Experience in Michigan

How has science advanced the cause?



Delaware, Marechal Foch, Vignoles, Seyval

Sabbatini P. and G.S. Howell 2010 Hortscience, Vol 45 (12) pp 1-5.

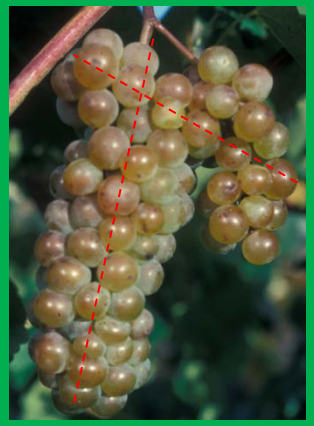
VEREP Viticulture and Enology Research and Extension Program

Viticulture MICHIGAN STATE UNIVERSITY

Impact of leaf Removal on Cluster Compactness

Some results: Vignoles

Fruit set (%)	Basal leaves removed 0	4	6
Shoot	60.0 a	45.0 b	35.0 c
Basal cluster	54.0 a	42.0 b	27.0 c
Apical cluster	64.0 a	49.0 b	43.0 b



ICG[y]	Basal leaves removed 0	4	6
Shoot	5.5 a	5.0 a	3.0 b
Basal cluster	5.0 a	4.0 a	3.0 b
Apical cluster	6.0 a	6.0 a	3.4 b

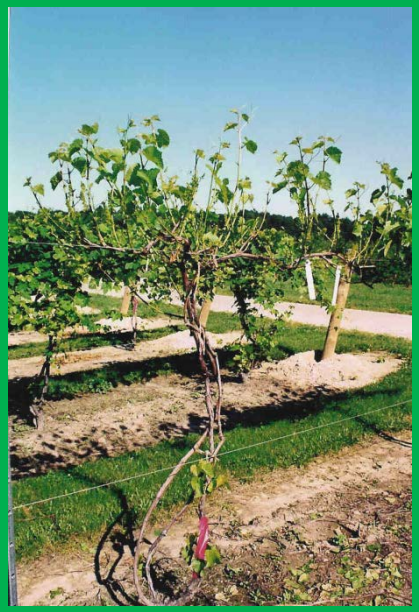
More results: Vignoles

Parametri[x]	Basal leaves removed		
	0	4	6
Cluster/vine	231.0 a	202.0 b	143.0 c
Cluster/shoot	2.0 a	2.0 a	1.9 a
Berry (g)	1.4 a	1.4 a	1.4 a
Berry/cluster	56.0 a	51.0 a	36.0 b
Cluster (g)	81.0 a	76.0 a	36.0 b
Brix (%)	19.6 a	20.6 a	22.2 b
pH	3.10 a	3.13 a	3.20 a
TA (g/L)	13.0 a	12.7 a	13.5 a

More results: Vignoles

	Basal leaves removed		
MR (%)	0	4	6
Incidence	24 a	16 b	2 c
Severity	20 a	12 b	0.5 c

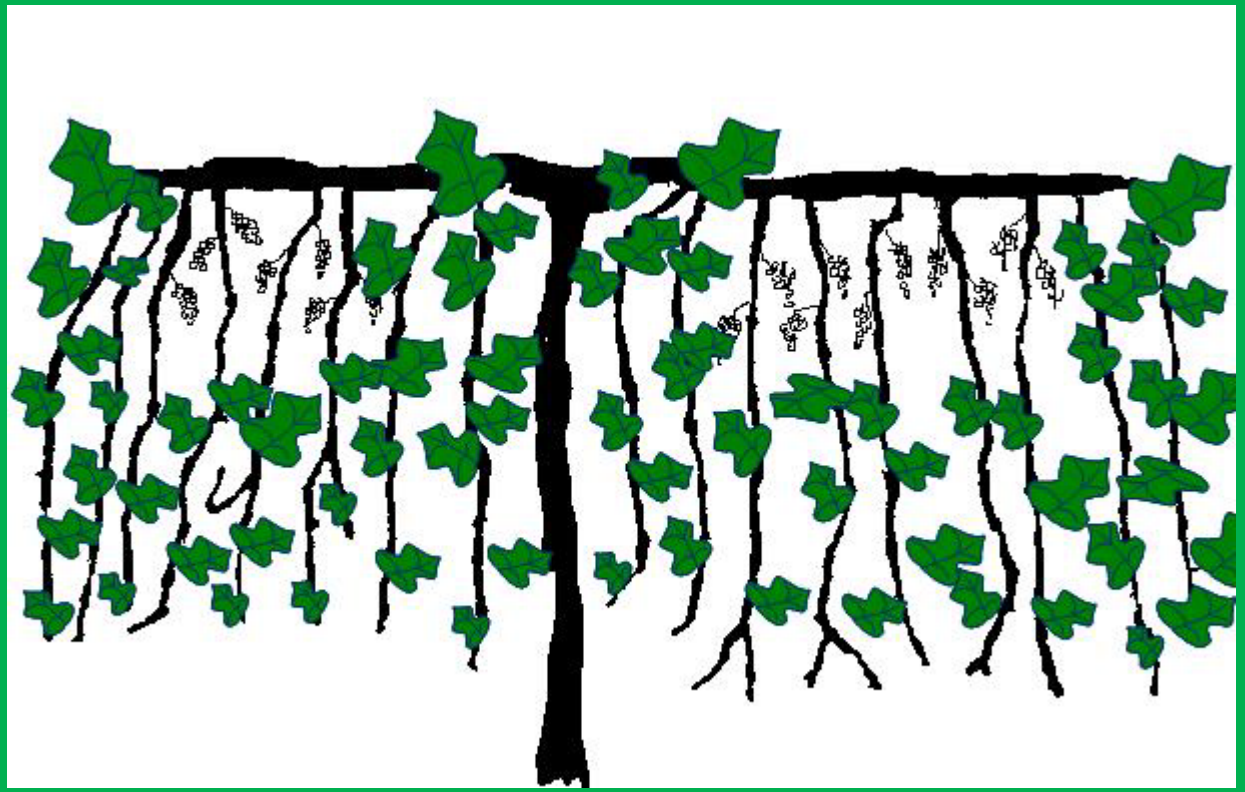
Problem in Vignoles – Year 2



Parametri[x]	Basal leaves removed 0	4	6
	Blind nodes (%)		
Node 1-4	20 a	26 b	27 b
Node 4-7	17 a	20 b	24 b
Per vine	29 a	28 a	33 a
	Cluster/Shoot		
Node 1-4	2.0 a	1.7 a	1.1 b
Node 4-7	2.0 a	1.9 a	1.7 b
Per vine	2.0 a	1.8 a	1.4 b
	Florets/cluster		
Apical cluster	273 a	271 a	248 b
Basal cluster	188 a	184 a	173 a
Per shoot	461 a	454 a	421 b
	Fruit set(%)[y]		
Apical cluster	100	84	20
Basal cluster	100	68	4
Per shoot	100	76	12
	Yield		
Vine (kg)	14.4 a	6.5 b	2.4 c

How to reduce carry over effect?

Use a training system that can allow year-2 crop bearing canes to be produced in conjunction with year-1 shoots bearing the crop



Avoiding Economic Losses Due to Poor Fruit-set, Spring Frost or Poor Growing Season

- Determine crop acceptable for “vintage year” weather
- Determine # nodes needed to get that amount of crop
- Assess shootless node and frost damage status in spring
- Assess fruit-set
- Assess quality of growing season
- Modify shoot or cluster number to achieve desired fruit quality goals

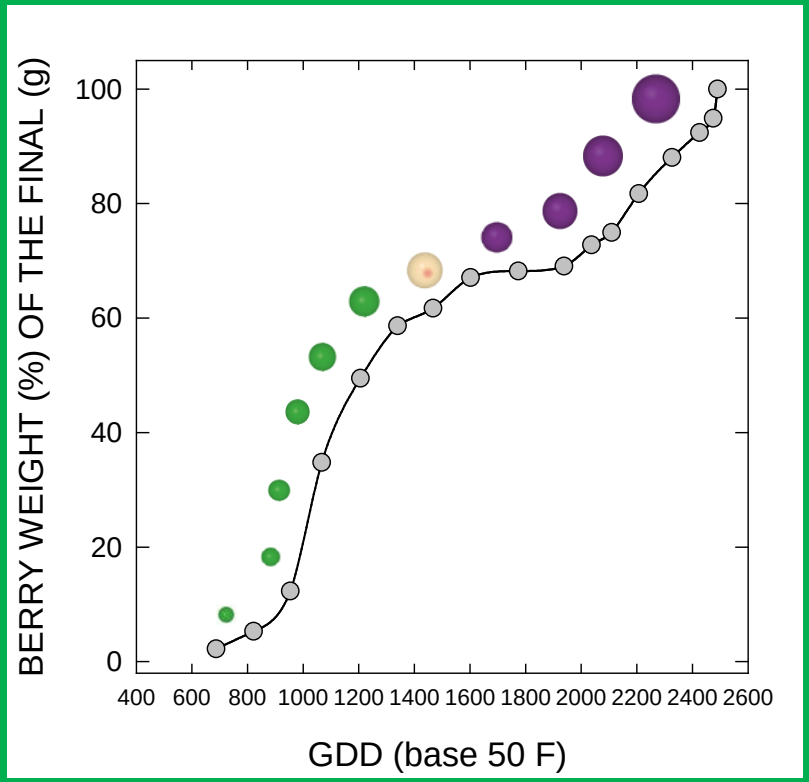
VITICULTURE & ENOLOGY

Yield manipulation to target fruit quality

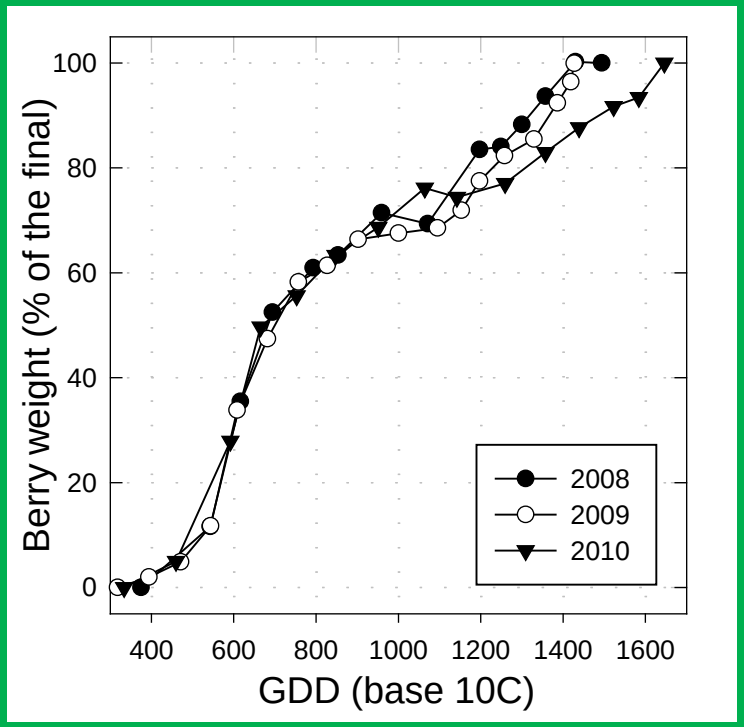
	Yield[x, y]		
Concord	H	M	L
Yield per vine (kg)	8.7 a	7.9 b	5.7 c
Berry weight (g)	3.7 a	3.9 ab	4.2 b
Berries/cluster	26.4 a	27.5 a	26.3 a
°Brix (%)	13.7 a	14.6 b	15.8 c
pH	3.2 a	3.2 a	3.3 a
Titratable acidity (g/L)	6.9 a	7.2 a	7.1 a

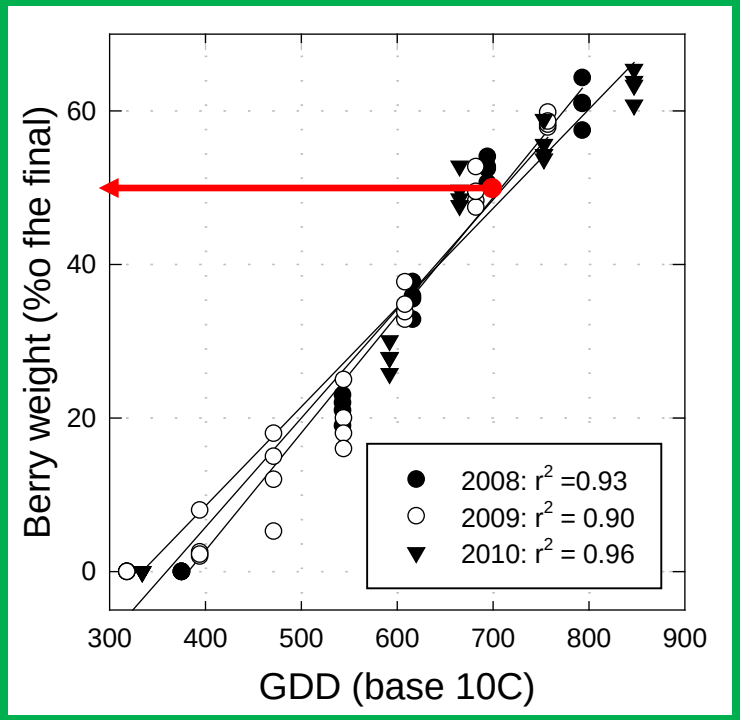
[x]Means in a row followed by the same letters are not significantly different at P = 0.05 by the Tukey's HSD test.
[y]H, M, L = yiled per vine, High, Medium and Low, respectively.

Understanding grape berry development



Impact of Yield per Vine



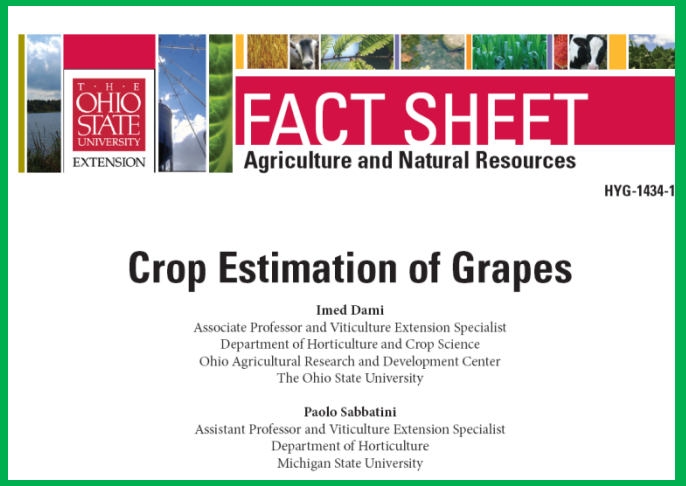


Sabbatini, Tozzini, Howell and Wolpert. 2011

680 GDD (base 10C)
1200 GDD (base 50 F)

Research and Extension

Variety	GDD 50%	GDD 50%	Variety Category
Chardonnay	1070	Early (1000-1200 GDD – 50%)	Vinifera
Pinot noir	1140		Vinifera
Pinot gris	1150		Vinifera
Cabernet Franc	1170		Vinifera
Marechal Foch	1180		Hybrid
Frontenac	1180		Hybrid
Vignoles	1180		Hybrid
Riesling	1190		Vinifera
Cabernet Sauvignon	1200		Vinifera
Concord	1210		Native
Chardonel	1470	Late (1400-1700 GDD -50%)	Hybrid
Pinot blanc	1470		Vinifera
Traminette	1470		Hybrid
Seyval	1500		Hybrid
Merlot	1700		Vinifera


THE OHIO STATE UNIVERSITY EXTENSION

FACT SHEET

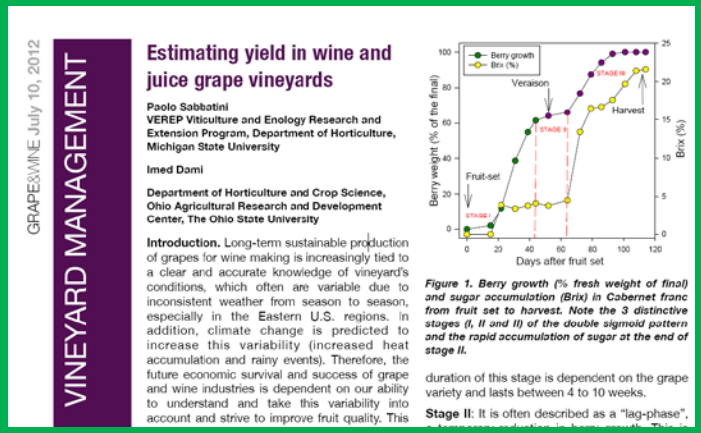
Agriculture and Natural Resources

HYG-1434-1

Crop Estimation of Grapes

Imed Dami
Associate Professor and Viticulture Extension Specialist
Department of Horticulture and Crop Science
Ohio Agricultural Research and Development Center
The Ohio State University

Paolo Sabbatini
Assistant Professor and Viticulture Extension Specialist
Department of Horticulture
Michigan State University


GRAPE&WINE July 10, 2012

VINEYARD MANAGEMENT

Estimating yield in wine and juice grape vineyards

Paolo Sabbatini
VEREP Viticulture and Enology Research and Extension Program, Department of Horticulture, Michigan State University

Imed Dami

Department of Horticulture and Crop Science, Ohio Agricultural Research and Development Center, The Ohio State University

Introduction. Long-term sustainable production of grapes for wine making is increasingly tied to a clear and accurate knowledge of vineyard's conditions, which often are variable due to inconsistent weather from season to season, especially in the Eastern U.S. regions. In addition, climate change is predicted to increase this variability (increased heat accumulation and rainy events). Therefore, the future economic survival and success of grape and wine industries is dependent on our ability to understand and take this variability into account and strive to improve fruit quality. This

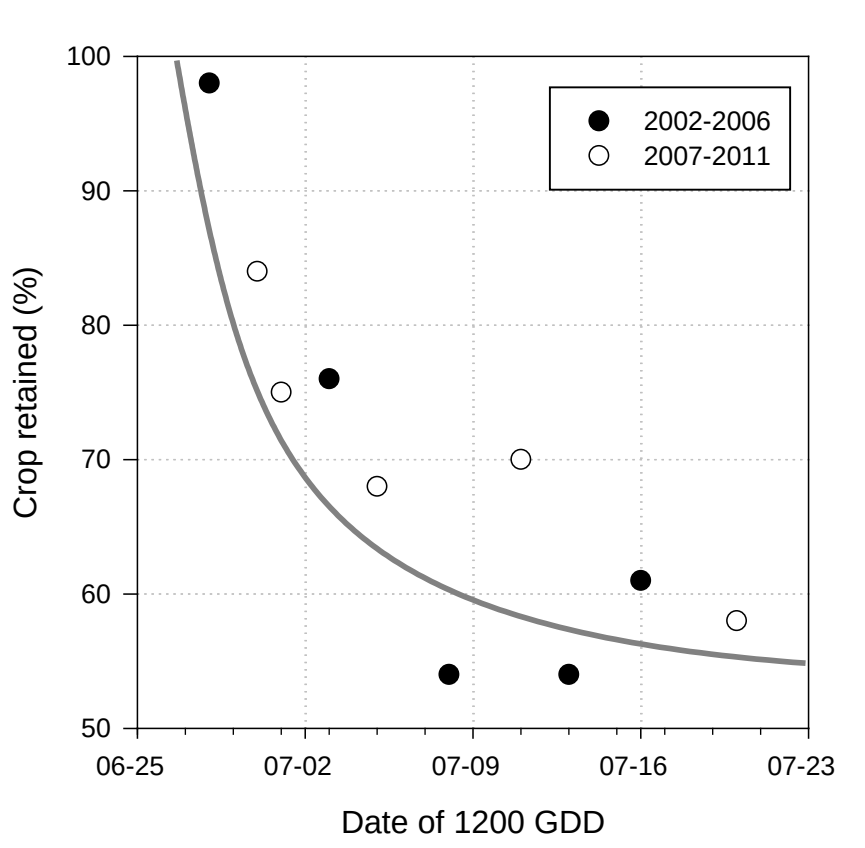
Figure 1. Berry growth (% fresh weight of final) and sugar accumulation (Brix) in Cabernet franc from fruit set to harvest. Note the 3 distinctive stages (I, II and II) of the double sigmoid pattern and the rapid accumulation of sugar at the end of stage II.

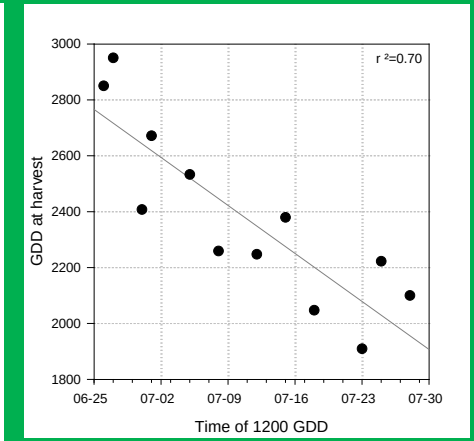
duration of this stage is dependent on the grape variety and lasts between 4 to 10 weeks.

Stage II: It is often described as a "lag-phase",

Sabbatini P., Dami I. and Howell G.S. 2012. Predicting Harvest Yield in Juice and Wine Grape Vineyards. Michigan State University Extension Bulletin E-3186: pp 1-15

Putting together small steps





Target industry fruit quality

=

16 Brix

Conclusions

- Challenges continue – Conditions of culture
- Continue to assess cultivars we call “standard” knowing some will ultimately be unacceptable
- Continue to follow fads, knowing we are at the ‘fringe’ of world wine production
- Continue the quest for cultivars which are not of our experience, and there are thousands

VITICULTURE & ENOLOGY

Acknowledgements

Michigan Grape and Wine Industry Council

VESTA – Viticulture and Enology Science and Technology Alliance

National Grape Cooperative/Welch's

Michigan Agricultural Experiment Station

eViticulture and Grape eXtension Community of Practice