Available Rootstocks and Varieties for Resilient Wine Grape Production

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What are the Concerns

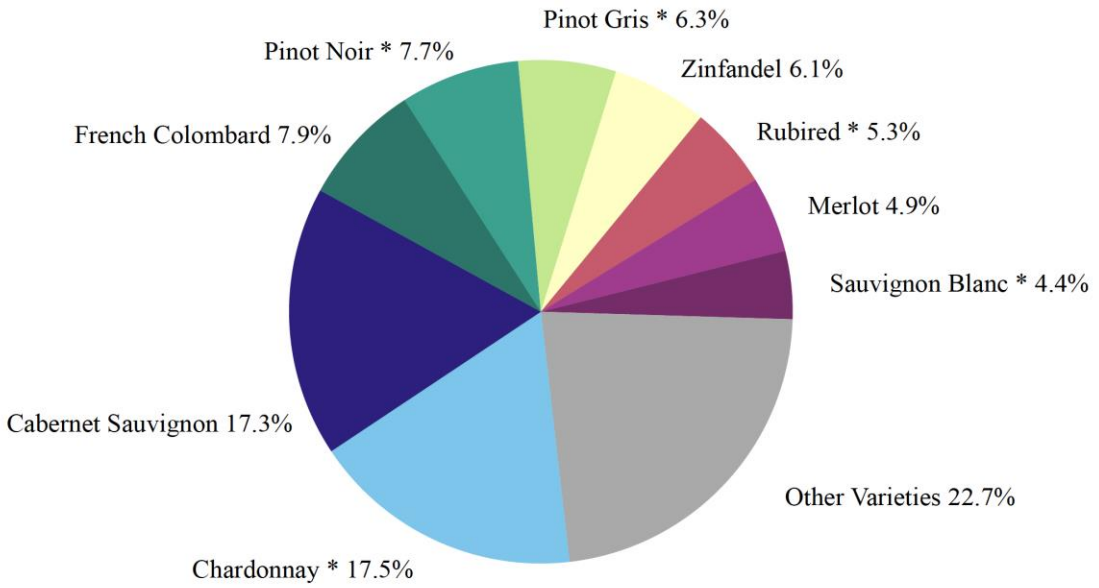
- Change in growing season length
- Earlier or later bud break and ripening
- Water availability
- Increased soil salinity
- More extreme weather events

Grapevine Cultivation

- Evidence of grape cultivation 8-9,000 years ago
- Evidence of wine production 6-7,000 years ago
- 5,000 to 10,000 grape varieties
- Wide range of varieties adapted to cool to hot growing conditions
- Use of rootstocks date to after the introduction of phylloxera into Europe mid-1800's

Leading Grape Varieties Crushed in California

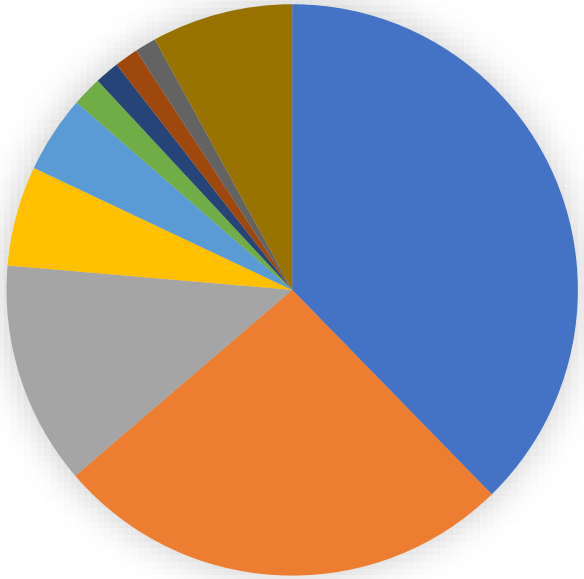
Percent of Total 2023 Crush [1]



Source: USDA, National Agricultural Statistics Service, Pacific Regional Office
*Synonyms for variety names are shown on Page 9 of the *California Grape Crush Report, Preliminary 2023.*
[1] Percentages may not add to 100%, due to rounding.

Top 9 = 77.4%

Grape Varieties Crushed in District 7 2023



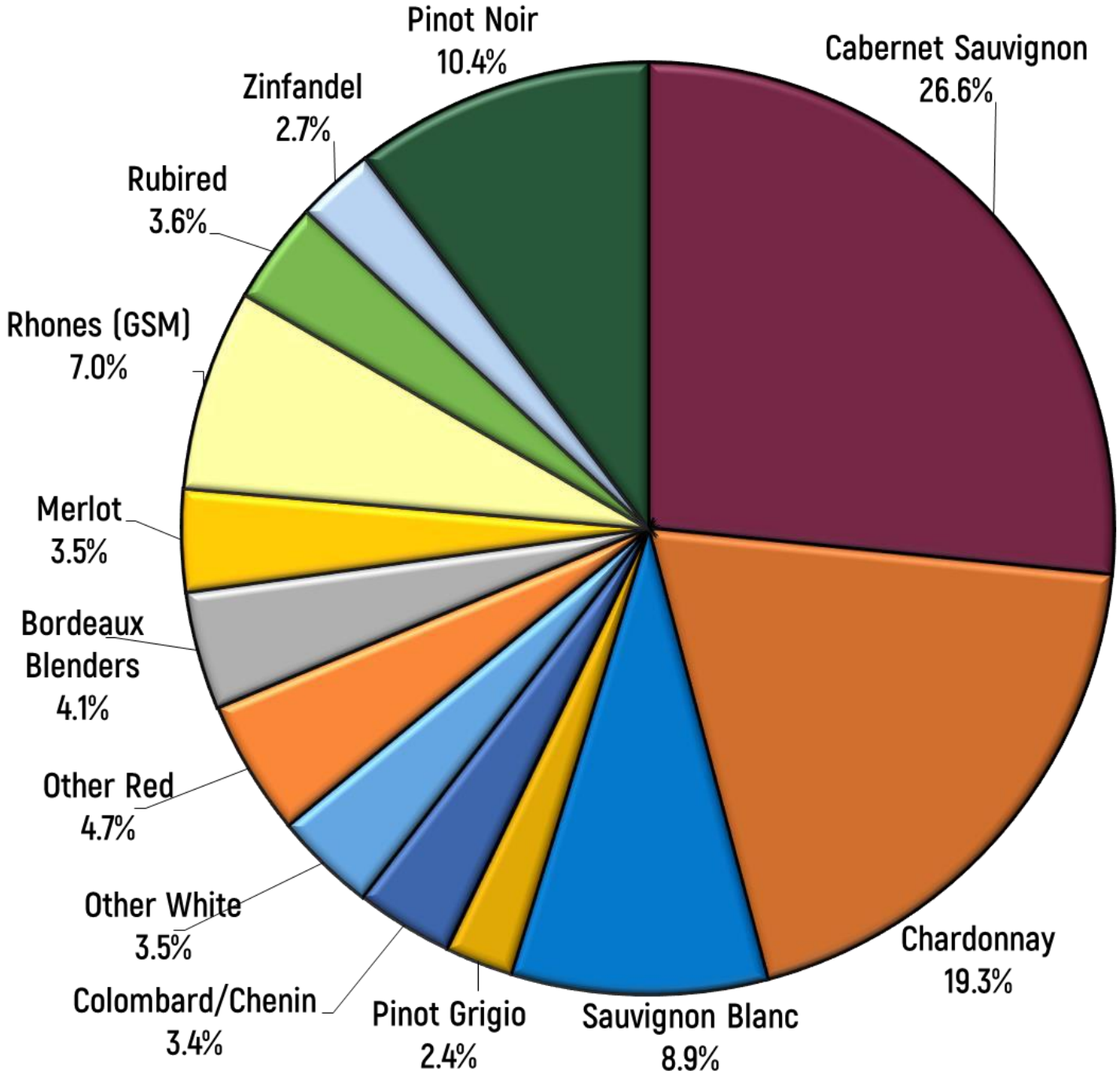
- Chardonnay 37.7%
- Pinot noir 26.0%
- Cabernet Sauvignon 12.6%
- Merlot 5.7%
- Sauvignon blanc 4.4%
- Syrah 1.7%
- Grenache 1.4%
- Malbec 1.3%
- Riesling 1.2%
- Other 8.0%

Top 9 = 92%
Top 3 = 76.3

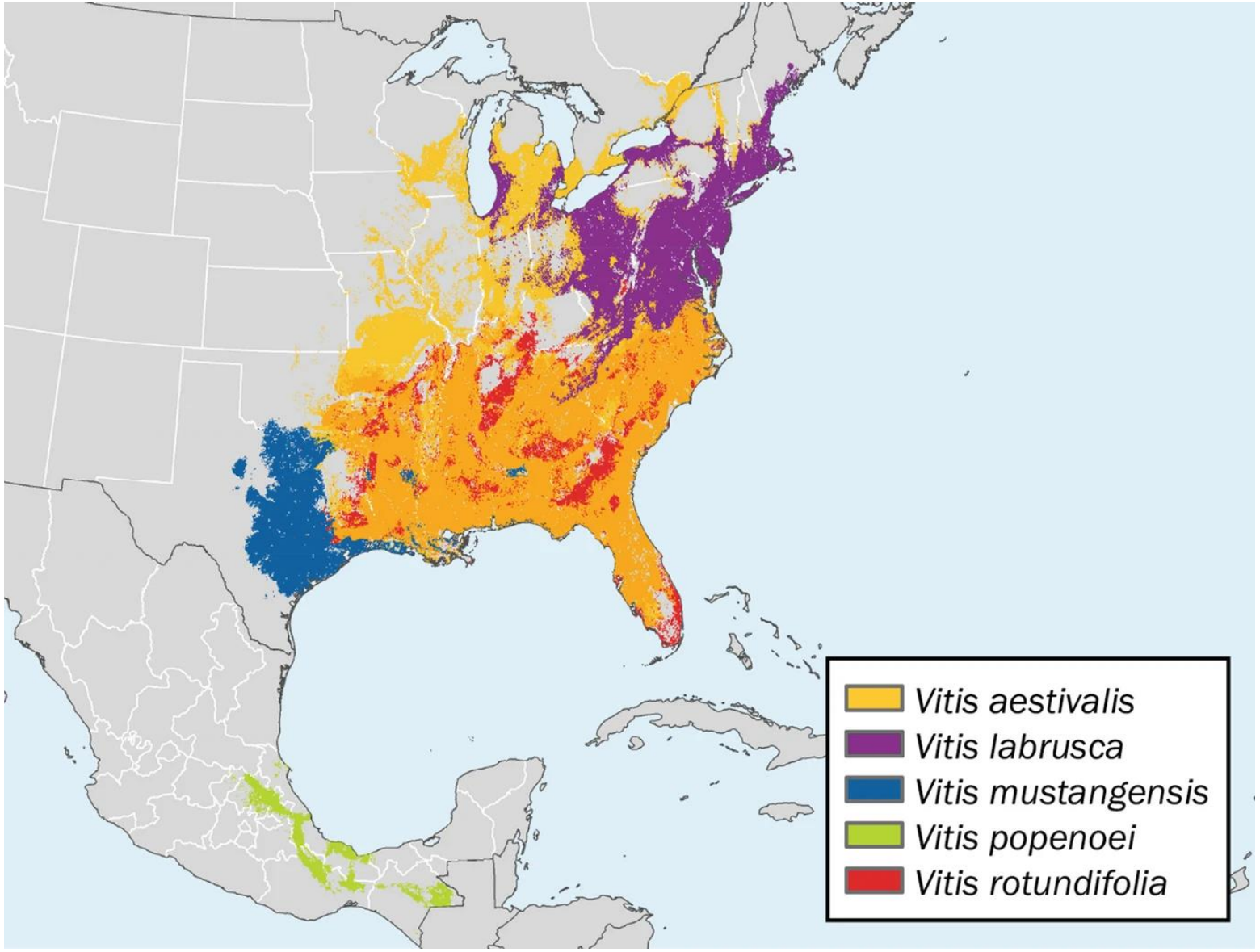
Nursery Survey

In California, 2023:
19 million winegrape vines sold
19,000 acres planted

Pie chart shows
percentage
of vines sold,
by variety/category,
not acreage



Vitis species used in cultivar breeding



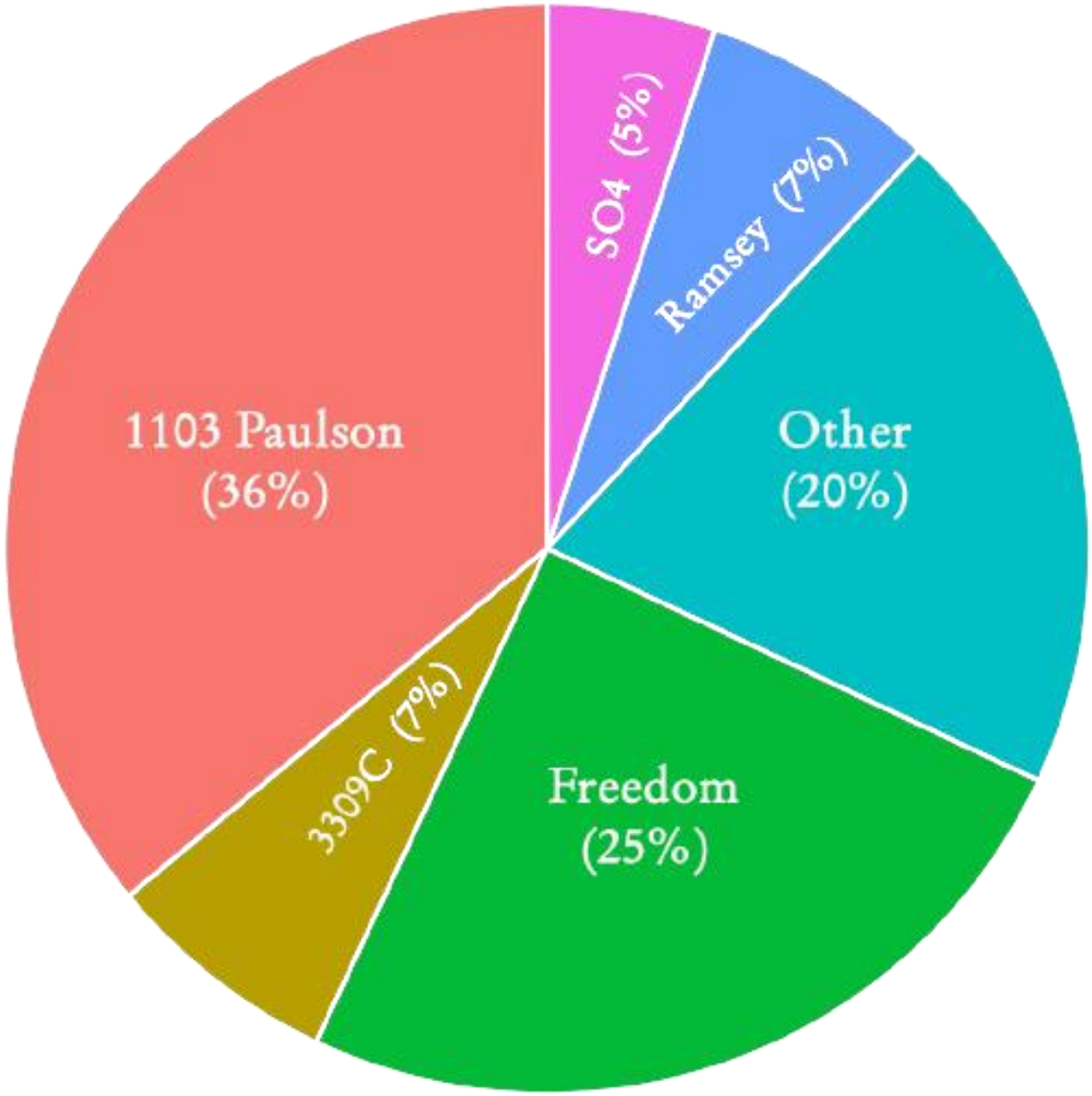
Heinitz et al. 2019

Climatic Adaptation

- Later bud break
- Moderate vigor
- Earlier fruit maturity
- Heat/drought tolerance
- Pest tolerance

Limited Rootstocks

- The trend observed in scions appears to hold true for rootstock varieties as well
- Data is sparse for rootstocks
- In 2022, we identified the most planted rootstocks across California from 2020-2022



Christopher Chen 2024

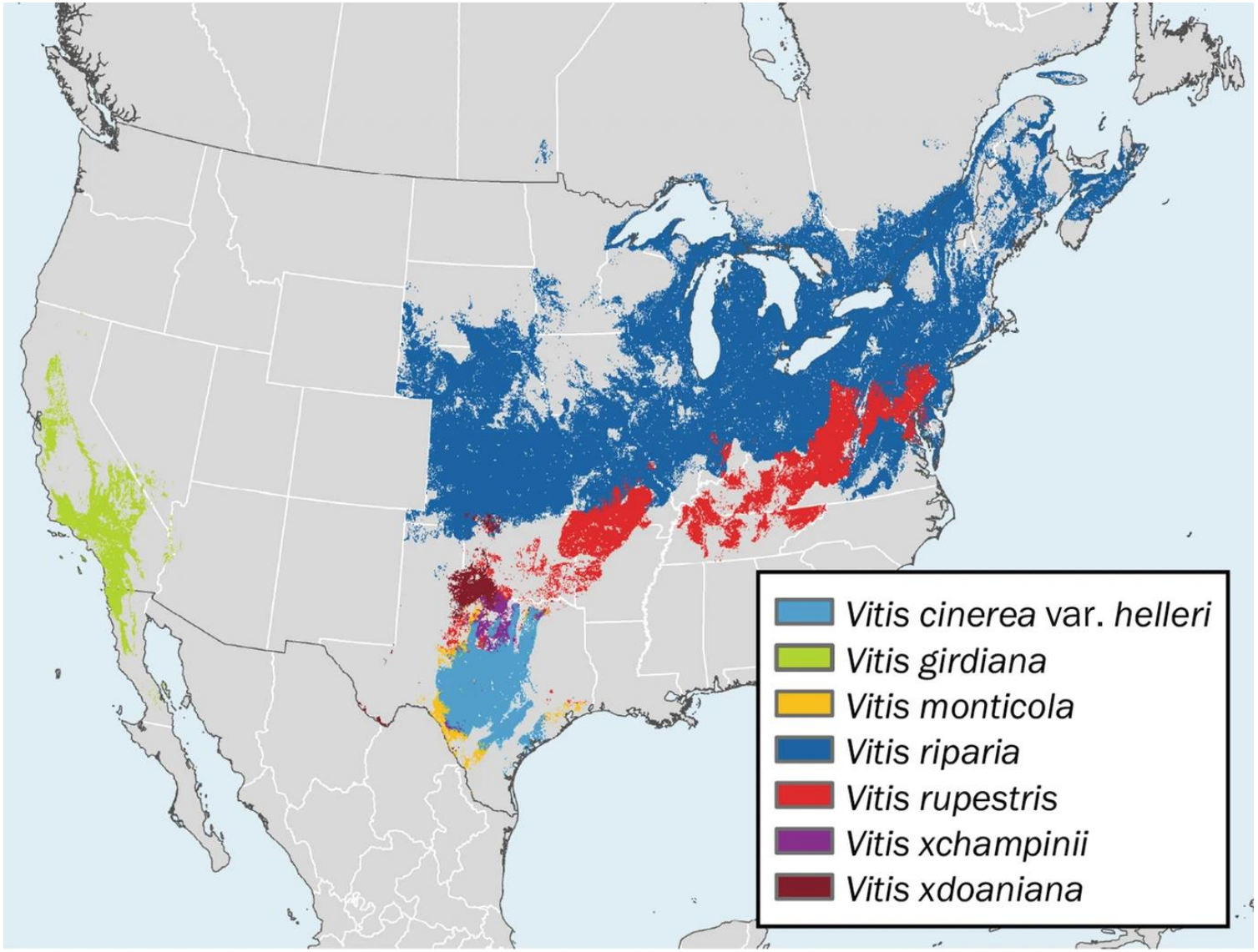
Rootstock Concerns/Issues

- Pest tolerance
- Grafting/ propagation success
- Drought and salt tolerance
- Cold tolerance
- Field performance

Effect of rootstock on shoot stunting
Chardonnay, San Lucas, 1999

Rootstock	Average shoot length, cm			
	June 16		Sept 18	
1103P	61	a	72	a
44-53	59	a	64	bc
140R	57	ab	68	ab
5C	55	abc	62	bc
5BB	54	abc	60	cd
SO4	50	bcd	58	cd
101-14	47	cd	63	bc
Salt Creek	42	de	62	bc
Freedom	39	ef	68	ab
110R	38	ef	53	d
420A	36	ef	45	e
3309	32	f	44	e

Vitis species used in rootstock breeding



Heinitz et al. 2019

Table 1. Main characteristics of the most used *Vitis* and *Muscadinia* species used to breed rootstocks (adapted from Boursiquot, pers. commun.)

	Vitis rupestris	***Vitis riparia***	***Vitis berlandieri***	***Vitis vinifera***	***Vitis candicans***	***Muscadinia rotundifolia***
Earliness	Medium to late	Very early	Late	Variable	Late	Late
Conferred vigour	High to very high	Low to medium	High	Variable	High	Low
Resistance to limestone	Low excepted R. Lot	Very low	Very high	Very high	Low	Very low
Resistance to drought	Medium	Low	High	Medium	High	Low
Resistance to salt	Medium	Almost none	Good chloride excluder	Fairly good	Fairly good	?
Rooting-grafting	Very good	Very good	Bad	Very good	Bad to medium	Bad
Resistance to phylloxera	High	High	Very high	None	Medium	Very high
Nematodes (*Xiphinema* and **Meloidogynes*)	Variable	Variable	Sensitive	Variable	Good resistance*	Good

Ollat et. al. 2016

Adaptive Viticulture

- Open to varietal change
- Rootstocks with improved characteristics
- Change in training trellis training systems
- Improved efficiencies that make vineyards more climate resilient

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