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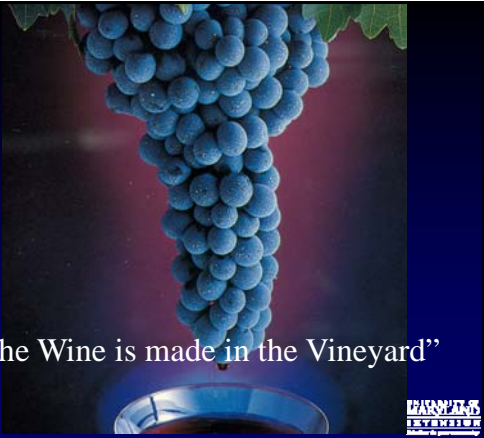


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**Monitoring Ripening
 for Harvest and
 Winemaking Decisions**

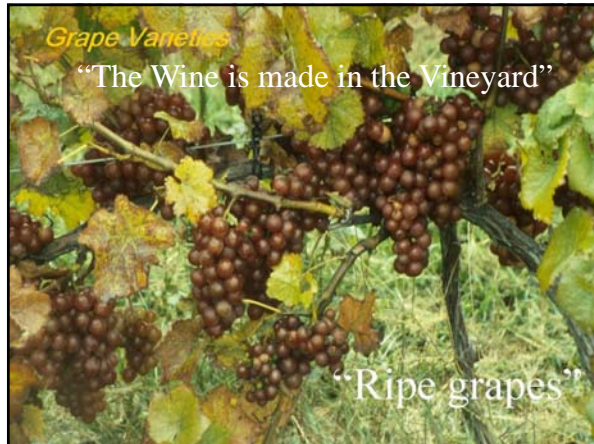
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“The Wine is made in the Vineyard”






Monitoring Ripeness

Objective:


- Produce best wine possible with a particular crop of fruit
- Understanding annual growing season variability



Monitoring Ripeness

Berry Ripening Stages:

- Vegetative Period
 - to 20 g/Kg sugar and acid
- *Veraison* – start of ripening
 - color change; swell; >elastic
- Maturation (40-50 days)
 - >sugar, <acid
- Over-ripening
 - <water; >concentration



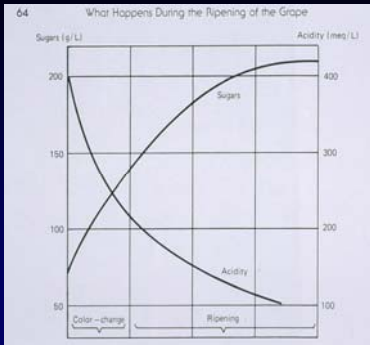
Monitoring Ripeness

Ripening Distinction:

- **Physiological Maturity**
 - the time when the grape reduces acid, increases sugar, ripens seeds, and reaches maximum berry diameter.
- **Technological Maturity**
 - the picking time in relation to ultimate utilization – making a “premium” wine



Monitoring Ripeness

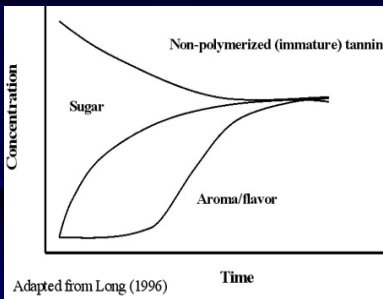


Increasing Sugars/Decreasing Acidity



Monitoring Ripeness

Relative Maturation Timeline



Monitoring Ripeness

°Brix/Maturity/Wine Quality

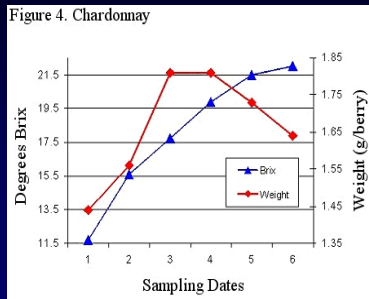
“Brix Fixation”

- Cold to Cool Climate
 - Brix strongly correlated to quality
- Warm Climate
 - Correlation much less robust



Monitoring Ripeness

Brix Increase vs. Dehydration



Monitoring Ripeness

Grape Maturity and Wine Quality

High quality wine is the confluence of

- Fruit derived flavor components
- Fruit derived aroma components
- Reduction of immature tannins
 - maturation

**Not necessarily corresponding to the desired sugar and acid ranges*



Monitoring Ripeness

Grape Maturity and Wine Quality

Primary metabolites:

- Sugar and related compounds

"Secondary metabolites":

- Fruit derived flavor components
- Fruit derived aroma components
- Tannins/phenols

**Note: Secondary metabolites are the main source of wine aroma, flavor, color, and taste sensations*



Monitoring Ripeness

Berry Maturity

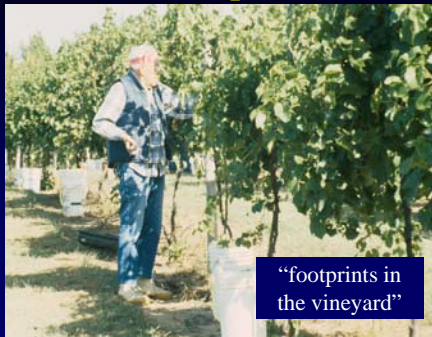
**NOTE: the physiological mechanism that the plant uses to make sugar is NOT the same as used to produce secondary metabolites such as aroma/flavor and phenolic compounds*

Source: Zoecklein (2001)



Monitoring Ripeness

Monitor/Sample Your Vineyard



"footprints in the vineyard"



Monitoring Ripeness

Berry Sampling

Important Principals:

- Random
- Un-Biased
- Representative

Source: Jordan and Croser (1983)



Monitoring Ripeness

Berry Sampling

- Avoid edge rows and first 2 vines in row
- Collect samples from both sides of vine
- For each row, estimate the proportion of shaded clusters and sample accordingly
- Collect berries from top, middle, and bottom of cluster
- Collect berries from all sides of clusters
- Maximum sample area should be $< 2A$

Source: Jordan and Croser (1983)



Monitoring Ripeness



**NOTE: About 90% of the variation in berry sampling is believed to come from variation in the position of the cluster and degree of fruit exposure*



Monitoring Ripeness



High
cordon

Strive for uniformity



Monitoring Ripeness



Strive for uniformity



Monitoring Ripeness

Berry Sampling

**NOTE: The greater the vineyard variability, the greater the potential negative influence on the wine, the larger the sample must be to get an accurate assessment of the maturity.*



Monitoring Ripeness

Grape Sampling - Accuracy

- Berry Sampling
 - +/- 1.0° Brix 2 x 100 berries
 - +/- 0.5° Brix 5 x 100 berries
- Cluster Sampling
 - +/- 1.0° Brix 10 clusters

Source: Jordan and Croser (1983); Kasimatis and Vilas (1985)



Monitoring Ripeness

Berry Sampling

NOTE: The most accurate sampling method is to take a **MINIMUM number of berries from a **LARGE** number of vines.*

Source: Zoecklein (2001)



Monitoring Ripeness

Evaluating maturity: *Priorities*

1. Quality and quantity of varietal aroma/flavor
 - Unripe/green – ripe/fruity – over/jammy
2. Texture of grape tannins
 - Suppleness/degree of polymerization
3. Seed ripeness
4. °Brix, total acidity, and pH
5. General fruit condition – berry softness
6. Berry size/weight
7. Ability to ripen further

Source: Zoecklein (2001)



Monitoring Ripeness

Development of Varietal Flavors and Aromas - Cabernet Sauvignon

Green

Herbaceous – “Stemmy”

Herbaceous – “Green Pepper”

Minty

Red Cherry – Black cherry

Blackberry

Black currant

Elderberry

Source: Zoecklein (2001)



Monitoring Ripeness

Berry Sampling/Wine Quality

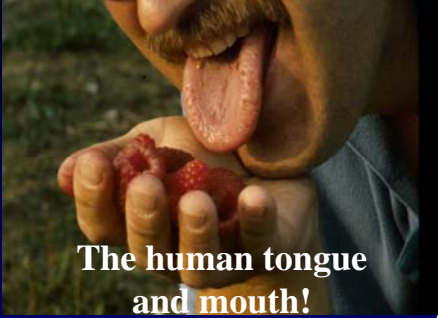
**NOTE: To obtain a desired characteristic aroma or flavor in the wine, it must be present in the grapes at the time of harvest, therefore the individual sampling must be diligent to monitor for that aroma and/or flavor in the sample.*



Monitoring Ripeness

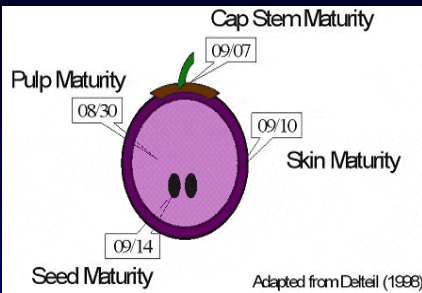


Monitoring Ripeness
The Most *Sensitive* Flavor Reception Apparatus
in the World!



The human tongue
and mouth!

Monitoring Ripeness
Berry Contents - Relative Maturation



Monitoring Ripeness
Berry Contents – Evaluating

“Organoleptic evaluation”

- Few “random” berries in mouth
- 1. Press out juice - do not chew seeds!
 - Evaluate for sugar and acid
 - Sugar front and acid back side of tongue
- 2. Spit out seeds into hand
 - Evaluate ripeness
- 3. Chew remaining skins
 - Evaluate astringency in cheek

Meritage cvs

Monitoring Ripeness

Evaluating maturity: *Priorities*

1. Quality and quantity of varietal aroma/flavor
 - green - herbaceous - fruity - jammy
2. Texture of grape tannins
 - Suppleness/degree of polymerization
3. Seed ripeness
4. °Brix, total acidity, and pH
5. General fruit condition – berry softness
6. Berry size/weight
7. Ability to ripen further

Source: Zoecklein (2001)



Monitoring Ripeness

Phenols and Wine Quality

- Structure
- Body or volume
- Tannin intensity and quality
- Astringency
- Bitterness
- Dryness
- Color
- Aging Potential



Monitoring Ripeness

Anthocyanin/Tannin

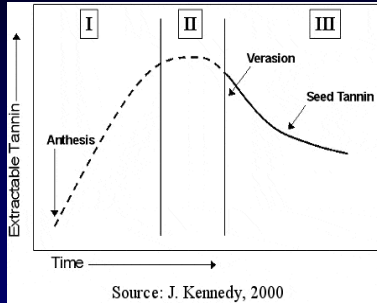
	<u>Red</u>	<u>White</u>
skin:	1859 (33%)	904 (23%)
pulp:	41 (0.1%)	35 (1%)
juice:	206 (0.4%)	176 (5%)
seed:	<u>3525 (63%)</u>	<u>2778 (71%)</u>
total:	5631	3893



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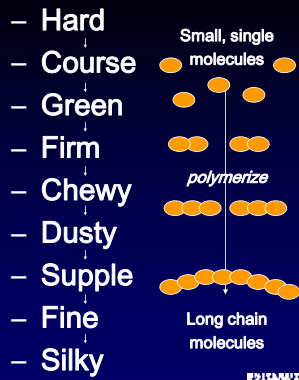
Tannin Maturity

Changes in Seed Tannin Extractability with Grape Maturity



Monitoring Ripeness

Development of Grape Tannins



Monitoring Ripeness

Evaluating maturity: *Priorities*

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 - green - herbaceous - fruity - jammy
2. Texture of grape tannins
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3. Seed ripeness
4. °Brix, total acidity, and pH
5. General fruit condition – berry softness
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7. Ability to ripen further

Source: Zoecklein (2001)



Monitoring Ripeness

Seed Ripeness



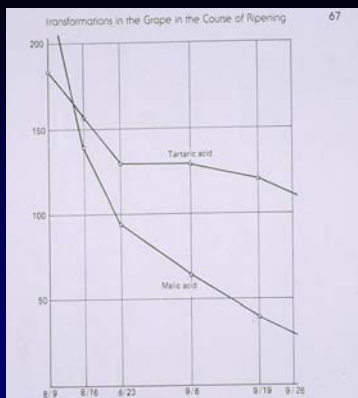
Monitoring Ripeness

Evaluating maturity: *Priorities*

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Source: Zoecklein (2001)

Monitoring Ripeness



Monitoring Ripeness

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Source: Zoecklein (2001)



Monitoring Ripeness

Cluster/Berry Condition

- Presence of disease
- Toughness of rachis
- Adherence of berries – shatter
- Diseases of rachis
- Drying and browning of rachis
- Skin toughness



Late-Season Rots



Botrytis



Ripe Rot



Bitter Rot



Sour Rot



Monitoring Ripeness

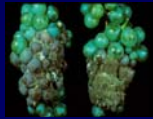


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Monitoring Ripeness

Must/Wine Oxidation

- Polyphenol oxidase
 - Grape enzyme
 - Sherry Madiera
 - Some phenols
 - Inhibited by SO₂
- Laccase
 - Botrytis enzyme
 - Most phenols
 - Resistant to SO₂
 - Must and wine
 - Extended activity



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Monitoring Ripeness

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4. °Brix, total acidity, and pH
5. General fruit condition – berry softness
6. Berry size/weight – “berry shrivel”
7. Ability to ripen further

Source: Zoecklein (2001)

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Monitoring Ripeness

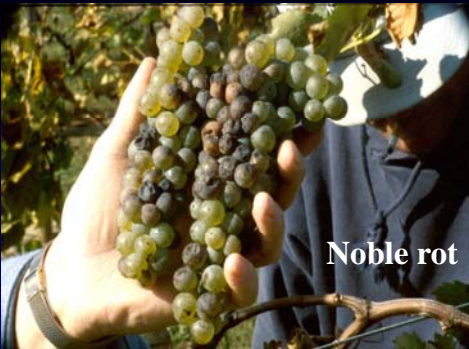
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Source: Zoecklein (2001)



Monitoring Ripeness



Noble rot



Monitoring Ripeness

Tannin Development

**NOTE: Tannins may continue to mature even late in the season when it would appear that no addition ripening can transpire.*



Monitoring Ripeness

Wine Styles:

- **Winemaker**
- **Know your clientele**

Winemakers have many options available to them



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“Wine makes daily living easier,
less hurried, with fewer tensions,
and more tolerance.”

~Benjamin Franklin

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