January 24, 2018

2:30 pm – 3:45 pm

Red Wine: Color and Tannin Development and Management

Markus Keller, Washington State University, Prosser

Unified Wine & Grape Symposium
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Managing Phenolics in the Vineyard

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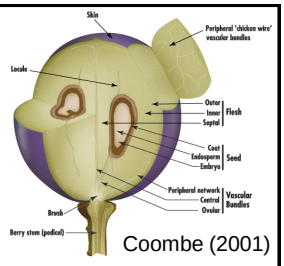
Phenolics for red wine

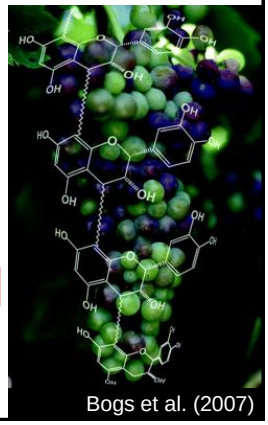
- **Hydroxycinnamates → Volatile phenols**
  - Tartrate esters in pulp and skin
  - Accumulate early, then often decline
- **Flavonols → Copigments**
  - Glycosides in skin
  - Accumulate throughout berry development
- **Flavan-3-ols → Tannins**
  - Monomers in skin and seed
  - Accumulate only before veraison
- **Tannins**
  - Oligo- and polymers in skin, seed, stem
  - Accumulate only before veraison
  - May continue to polymerize during ripening
- **Anthocyanins → Polymeric pigments**
  - Glycosides in skin (+pulp in teinturier cvs.)
  - Accumulate only during ripening (>9 Brix)



Coombe (2001)

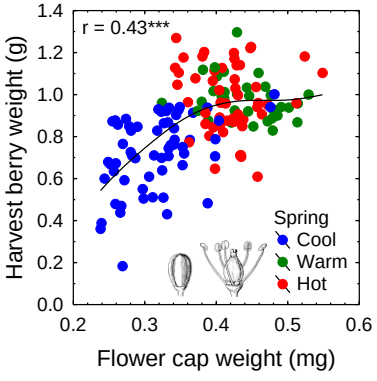
OFF

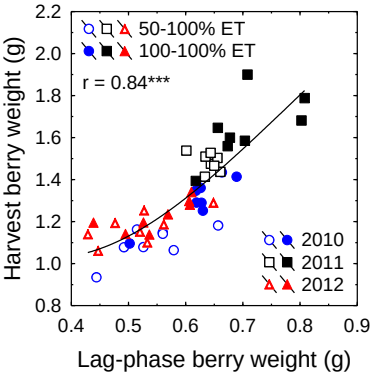
ON



Bogs et al. (2007)

Temperature and water limit berry size

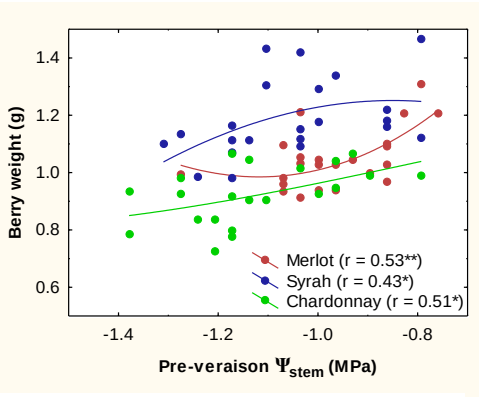




- Cool spring temperatures → Small flowers → Small berries
- Water deficit <u>before</u> veraison → Small berries
- Berry size is determined early → It is difficult to manipulate berry weight after veraison

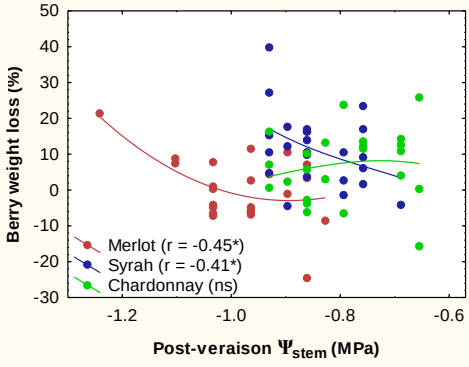
Keller et al. (2010) Keller (2015)

Diluting fruit quality – really?

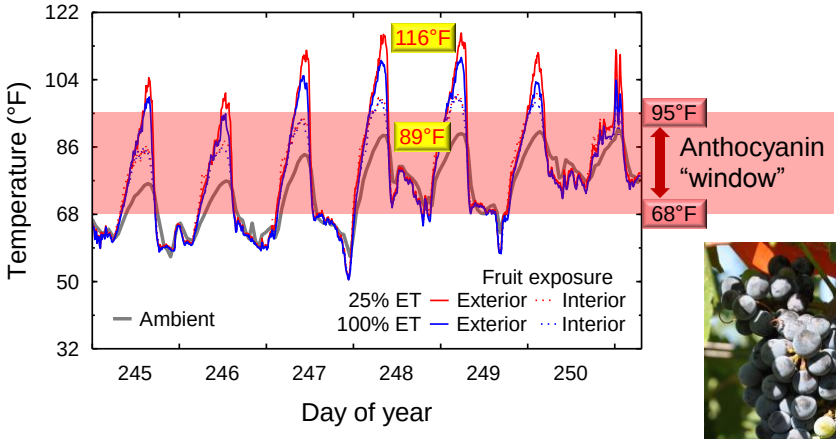


More water ***before*** veraison increases berry size

More water ***after*** veraison decreases berry shrinkage



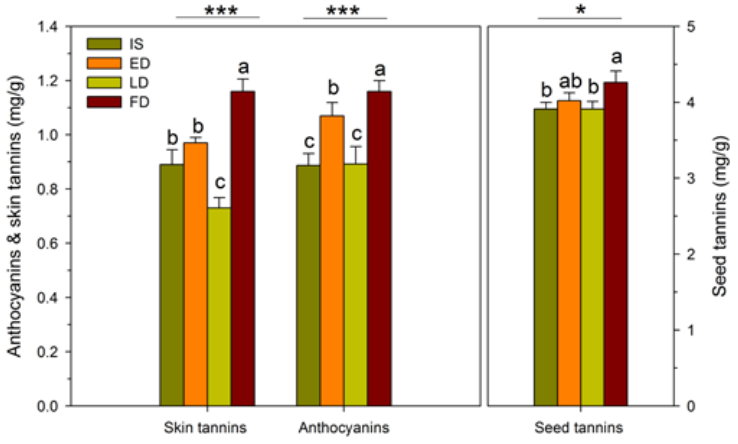
Water deficit: It's not just about berry size



- Water deficit → Small berries, low vigor
  - → Open canopy, restricted shoot growth
  - → High cluster sun-exposure
  - → High light and high temperature
- Exposed berries are warm berries

Keller et al. (2016)

Deficit irrigation: A tool for wine quality

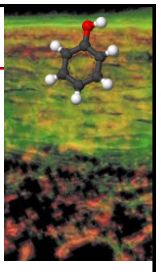


- Full-season deficit (35% ET_v) → More anthocyanins, tannins → More LPP
- Preveraison deficit → Intermediate anthocyanins, tannins
- Postveraison deficit → No anthocyanin gain, lower skin tannins than industry standard (70% ET_v)

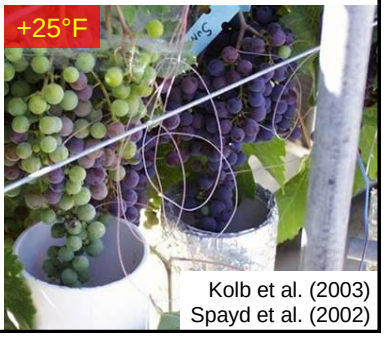
→ Dehydration does not make fruit more mature

Casassa et al. (2015)

Sun exposure: Light or heat?

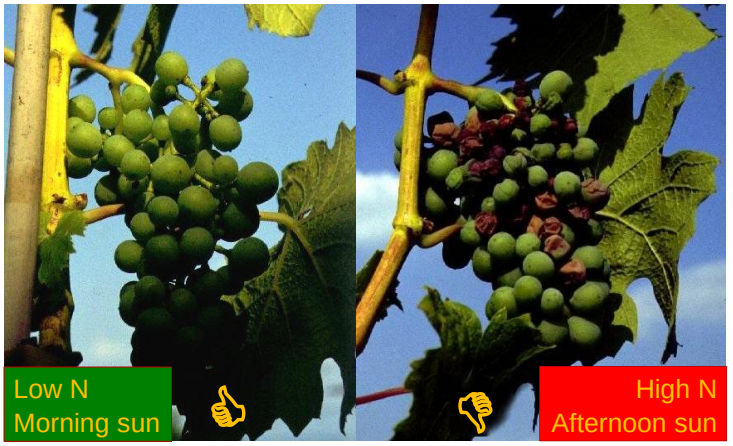


- **Visible light** (>5% full sun) stimulates anthocyanins, hydroxycinnamates, slightly skin tannins
- **UV light** strongly stimulates flavonols
- **Temperature** optimum is 68-95°F for anthocyanins but <68°F for flavonols; both are inhibited/degraded above 95°F (tissue temperature!)
- Heat, low light shift anthocyanin profile towards malvidin
- Higher preveraison temperatures increase tannins
- Unclear temperature effect on hydroxycinnamates
- Sun-exposed berries: 6-8x flavonols, 2-4x flavan-3-ols (mono-, oligo-, polymers) than shaded berries



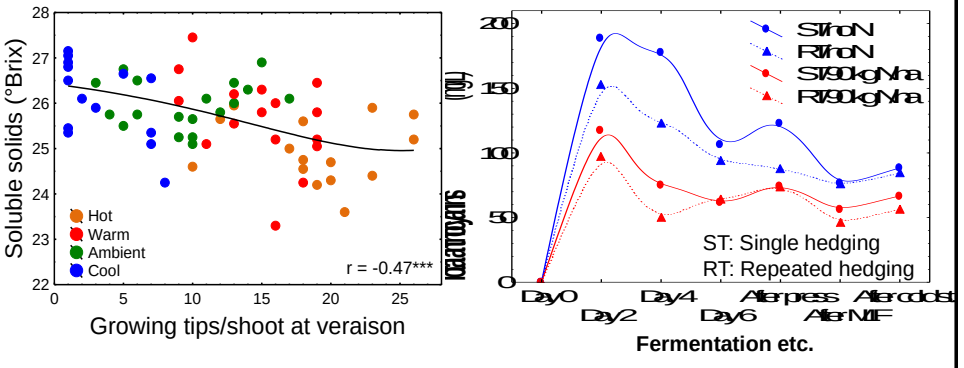
Kolb et al. (2003)
Spayd et al. (2002)

Sun exposure: How much is too much?



- Leaf removal: Do it early! Be careful on west/south side!
  - ✓Prebloom → Reduces cluster compactness, overcropping
  - ✓2-4 weeks after fruit set → Enhances sun exposure
- Bad recipe: Too much, too late (veraison or later) → Sunburn

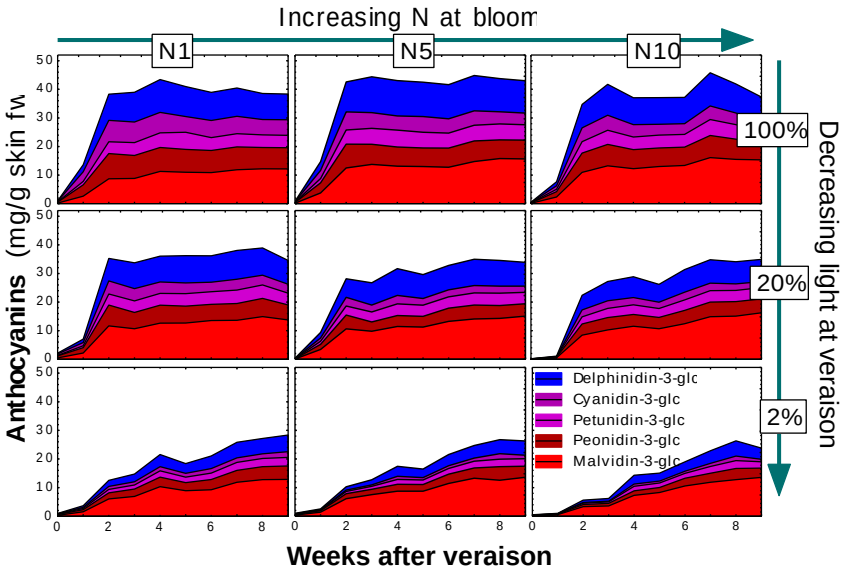
Nitrogen: Moderation is a virtue



- More N → Higher yield, more lateral growth, denser canopy
- Growing shoot tips compete with fruit → Delayed ripening
- N suppresses secondary metabolism (phenolics)
- Bad recipe: Apply N fertilizer, then hedge away excess growth

Keller et al. (1999, 2001, 2010)

Nitrogen: Interaction with light



Light drives anthocyanin accumulation, but N modulates it

Keller & Hrazdina (1998)

Summary: Vineyard practices for phenolics

- Vintage variation in phenolics as high as cultivar variation
  → Cultural practices can only fine-tune what nature imposes
- Unclear effect of **crop load**

  (Overcropping delays ripening but is often coupled with shade effect)
- **Low vigor** increases anthocyanins, skin tannins
- **Sun exposure** increases flavonols, anthocyanins, skin tannins, but decreases tannin extractability

  (Mostly due to more light – beware of excessive temperature!)
- **Water deficit** increases anthocyanins, skin tannins

  (Mostly due to lower vigor, greater fruit exposure, and smaller berries)
- **Nitrogen** (but not P or K) **deficit** increases all phenolics

  (Due to lower vigor, greater fruit exposure, and stimulation of phenolics production: nitrate suppresses “phenolics genes”)

It's in the book

Second Edition

2015

Academic Press (Elsevier)

Amazon