Achieving Vine Balance and the Role of Rootstocks

Foothill Grape Day
UC Cooperative Extension – Amador Co and El Dorado Co.
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- Team Members
  - Mike Anderson, Jason Benz, Janet Myers

Brief Outline

- Vine Balance
  - Principles (from literature)
  - Factors affecting balance
    - Shoot number at pruning (data)
    - Rootstock contribution (data)
  - Conclusions
- Fruit thinning (a little more data)
  - Conclusions
- Question and Answer

Vine Balance

Working Definition:

- When grapevine growth is appropriate for the trellis and spacing
- And the leaf area and amount of fruit are in proper proportion

How many of you have read?

- Planting density and physiological balance: Comparing approaches to European viticulture in the 21st century. Intrieri, C. and I. Filippetti. 2000.
- *In:* Proceedings of the ASEV 50th Anniversary Annual Meeting, pp 296-308, American Society for Enology and Viticulture, Davis, CA.
- Summary in Wine Business Monthly, April, 2007.

- Leaf area/crop weight ratios of grapevines: Influence on fruit composition and wine quality.

  Kliewer, W. M. and N. K. Dokoozlian. 2000.
- *In:* Proceedings of the ASEV 50th Anniversary Annual Meeting, American Society for Enology and Viticulture, Davis, CA.
- American Journal for Enology and Viticulture 56:170-181. 2005.

Vine Balance

Two major contributors

- Conditions of balance are set at planting in the vineyard design (permanent)
  - Soil
  - Rootstock/scion
  - Spacing – row x vine
  - Trellis
- Conditions of balance are acted on by cultural practices (annual)
  - Pruning (shoot number)
  - Nitrogen application
  - Irrigation
  - Cover crops

Vine Balance

- Contributions to vine vigor
  - Given
    - Soil (fertile vs less)
    - Scion (high vigor vs low)
  - Decisions
    - Rootstock (high vigor vs low)
    - Spacing (wide vs narrow)
      - In-row (more than between-row)
    - Trellis (divided vs undivided)

Two Scenarios

- Scenario 1
  - Given
    - Soil: Deep, fertile
    - Scion: Cab Sauv
  - Decision
    - Rootstock: ?
    - Vine spacing: ?
    - Trellis: ?
- Scenario 2
  - Given
    - Soil: Shallow, infertile
    - Scion: Pinot noir
  - Decision
    - Rootstock: ?
    - Vine spacing: ?
    - Trellis: ?

Decisions affect vine balance
within given scenarios

- “Spacing defined solely by R x V spacing is only a beginning in the definition of canopies and within-canopy spacing of leaves.”
  - Nelson Shaulis 1980. Responses of grapevines and grapes to spacing of and within canopies. Proceedings of the Centennial Symposium, 1880-1980, UC Davis *(emphasis added)*

Dokoozlian and Kliewer
Amer J. Enol. Vitic. 1995

- In too-dense vine canopies:
  - High leaf layer number (by point quadrat analysis)
  - High LA/m row (>1.5 m^2/m row) (by leaf area meter)
  - Low PPFD (light): <2% of ambient (by light meter)
  - Low Red:Far-red light ratio (by spectroradiometer)
  - Low sunflecks in fruit zone (sunfleck ceptometer)
  - Low evaporative potential (by atmometer)

- How many of these can <u>you</u> measure?

Dokoozlian and Kliewer
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Fortunately:

- **All are correlated with pruning wt!**

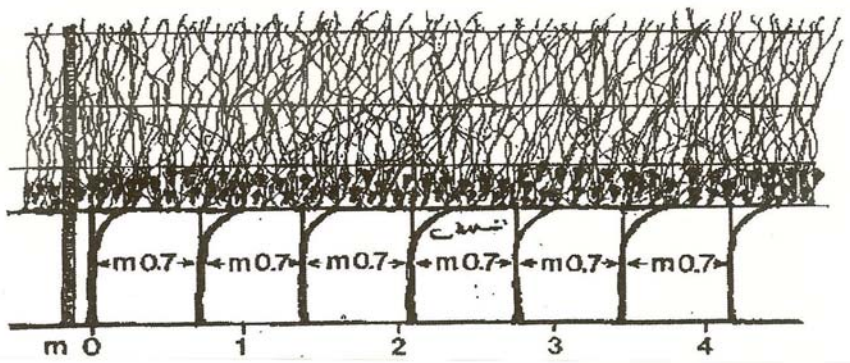
Growth measurement

- Pruning wt
  - Expressed per vine is not helpful
  - Expressed per meter (or per ft) is helpful
- Pruning wt metrics
  - Smart and Robinson: 0.3 – 0.6 kg/m
  - Dokoozlian & Kliewer: 1.0 kg/m for Cab Sauv.

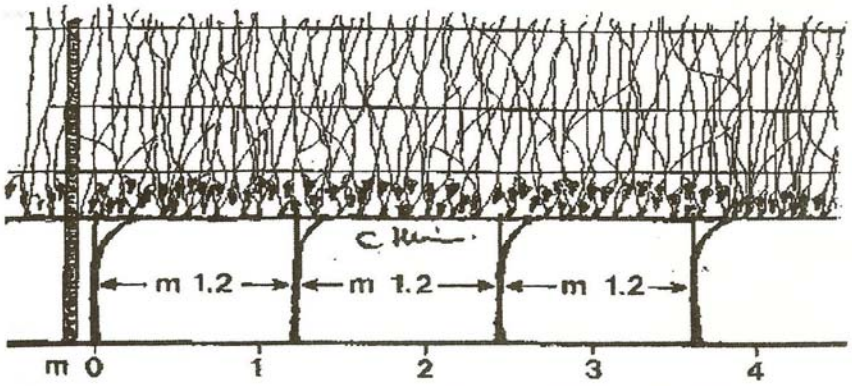
Even more informative than pruning wt alone

- Shoot number
- Shoot wt

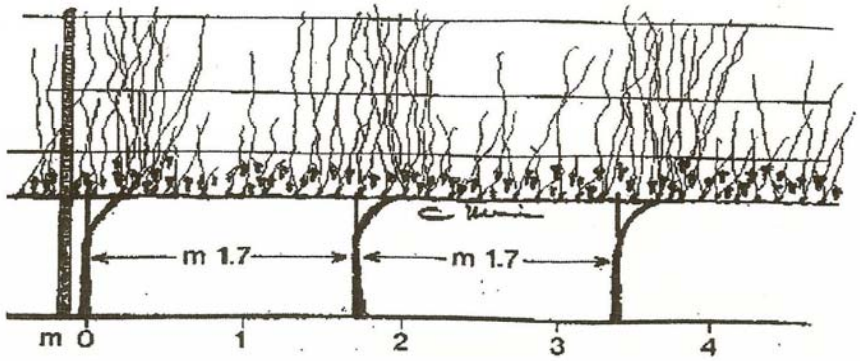
Too Narrow



Optimum



Too Wide



From: Intrieri and Filipetti American Journal of Enology and Viticulture, 50th Anniversary

Shoot number

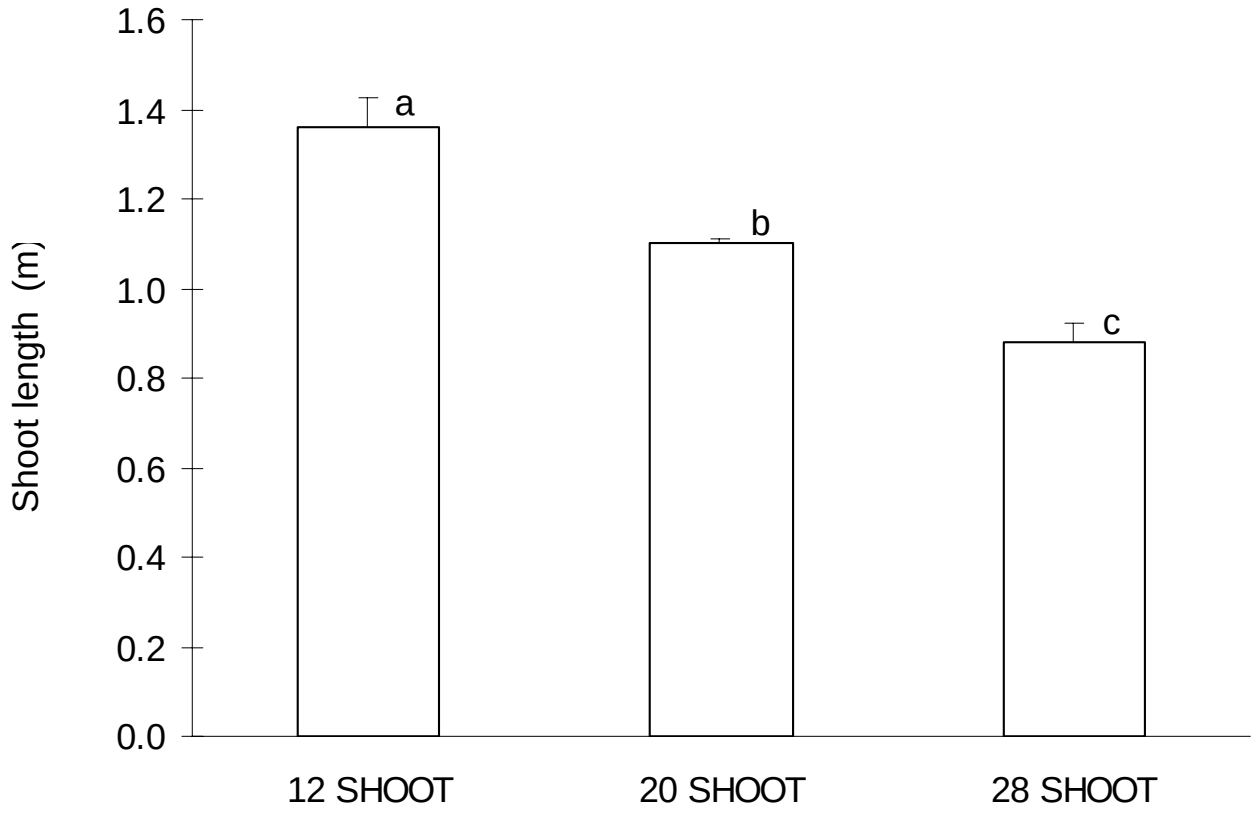
- Recommended shoot density
  - For cordon-training, undivided
  - 12-15 shoots/meter

- One cannot achieve vine balance by adjusting shoot number out side this range.

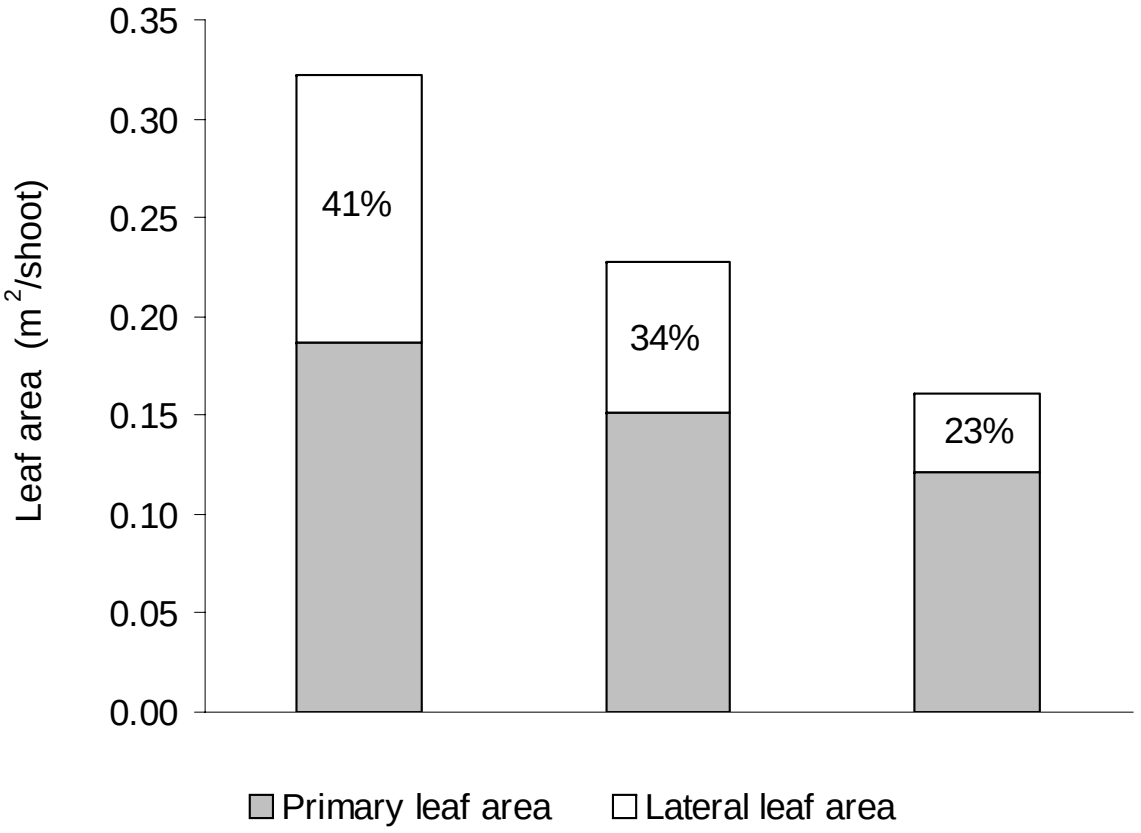
Sangiovese Study

- Sangiovese/3309C (5th leaf)
- Atlas Peak Vineyards, Napa
- Three treatments
  - 12, 20 and 28 shoots per vine
- Adjusted in spring

Shoot number affects shoot length

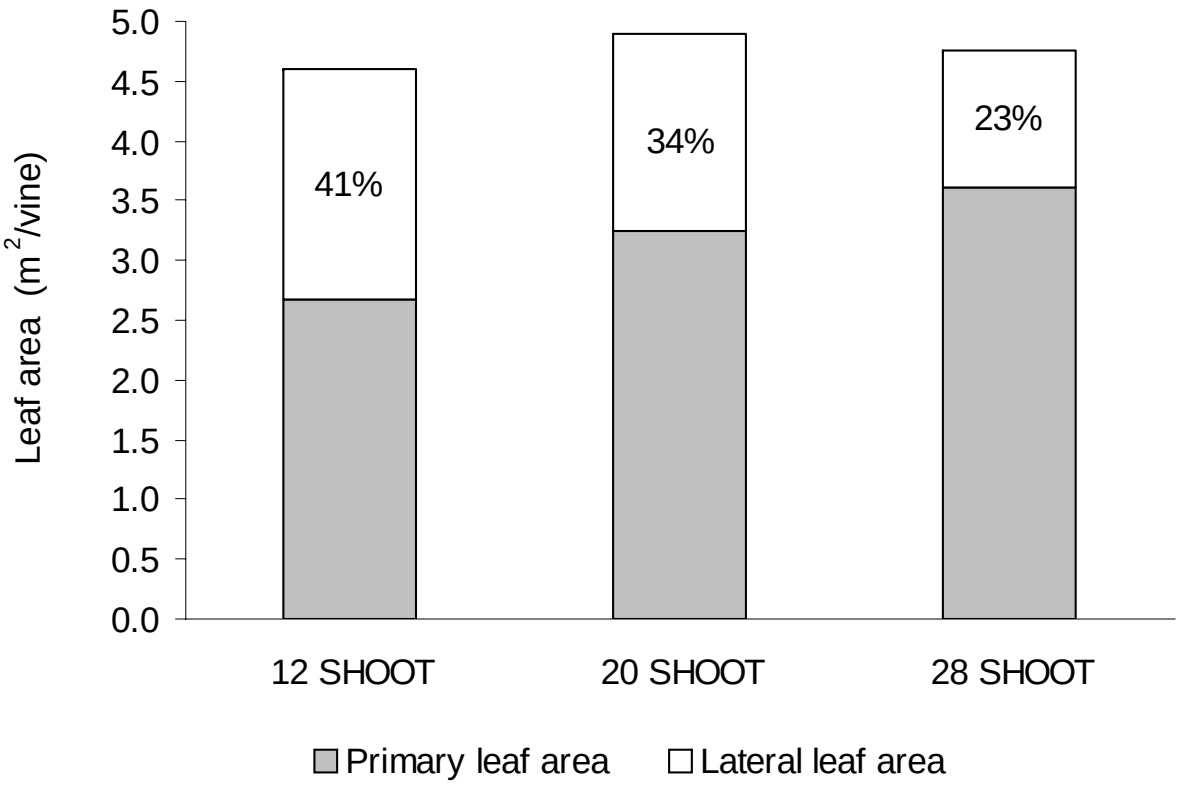


Longer shoots have more leaf area and have a greater % of leaf area as laterals

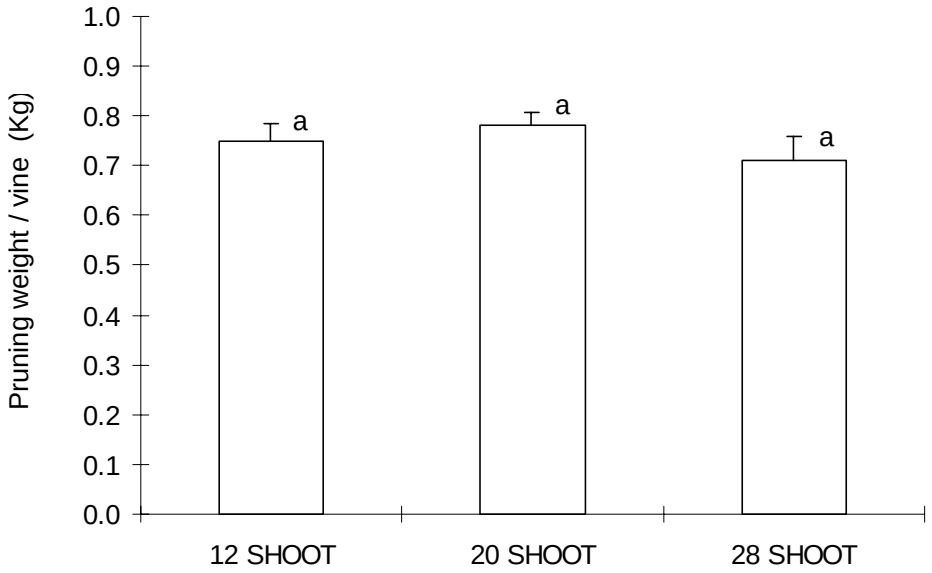


Manipulating shoot number per vine does not change leaf area per vine, but changes % primary vs. lateral

(J.K. Myers and J.A. Wolpert, unpublished data)



Pruning wt unaffected by shoot number



Myers, J. and J. Wolpert. Unpublished data.

Shoot number vs. primary and lateral leaf area

Primary shoots/m Canopy	Canopy leaf area (m^2/m)	Primary LA (m^2/m)	Lateral LA (m^2/m) (%)
6	7.2	3.4	3.8 (53%)
12	7.4	4.6	2.8 (38%)
24	9.2	6.7	2.5 (27%)

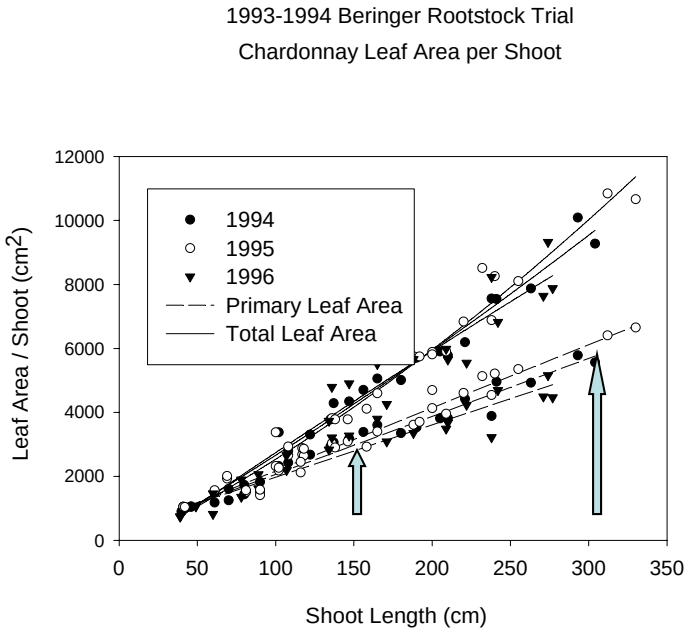
Dokoozlian Thesis, 1990
(Unpublished data)

Conclusions from Shoot Number work

- For vines of a given vigor, decreasing shoot number :
  - Redistributes LA from shorter shoots to longer shoots and
  - Increases % lateral LA (in the fruiting zone?)
  - Increases the LA to fruit wt ratio (m^2/kg)
  - Decreases the fruit yield/cane prunings ratio (kg fruit/kg prunings)

Rootstocks:

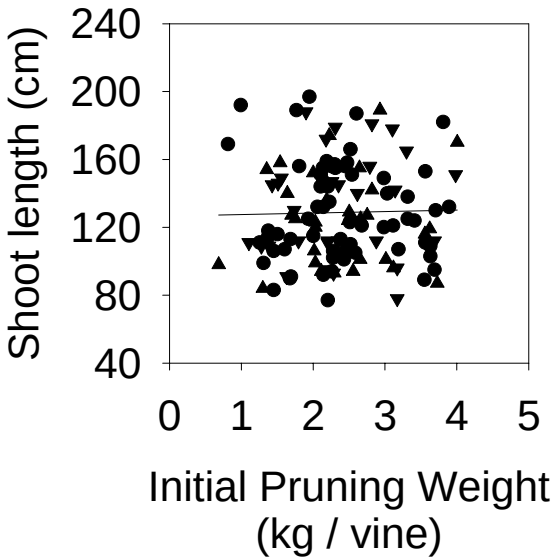
Effect of shoot length on primary and total leaf area.

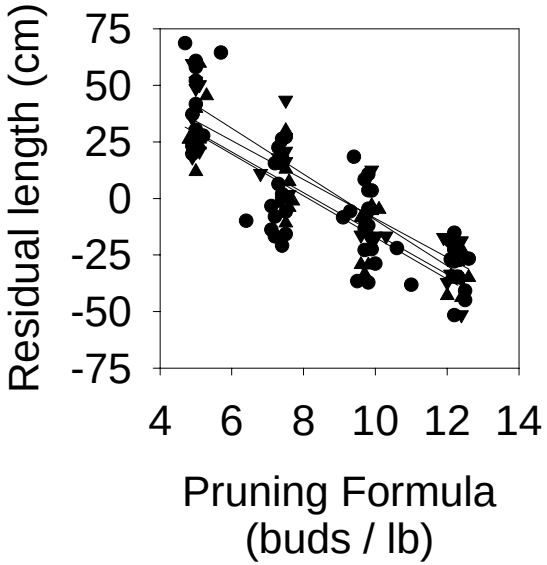


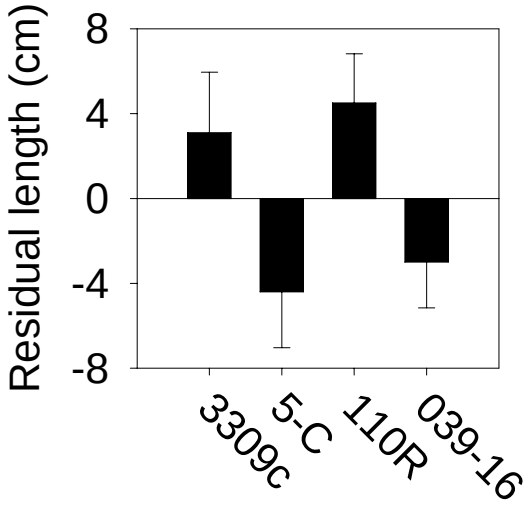
Note: % lateral leaf area increases as shoot length increases.

Oakville Cabernet Sauvignon

- Treatments
  - 4 Rootstocks: 3309C, 5C, 110R and O39-16
  - 4 Pruning levels: 5, 7, 10 and 12 buds per lb of prunings
- Conditions
  - Range of vine size from 1 to 4 kg/vine (0.5 kg/m to 2.0 kg/m)

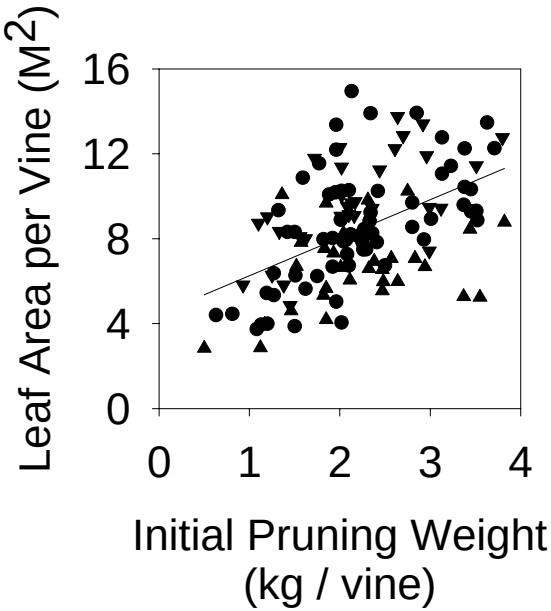


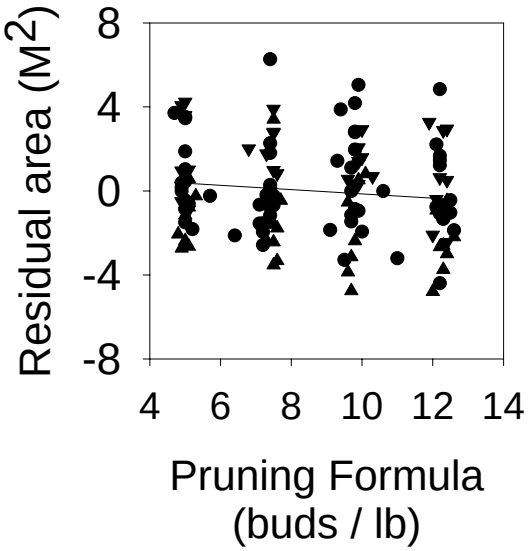


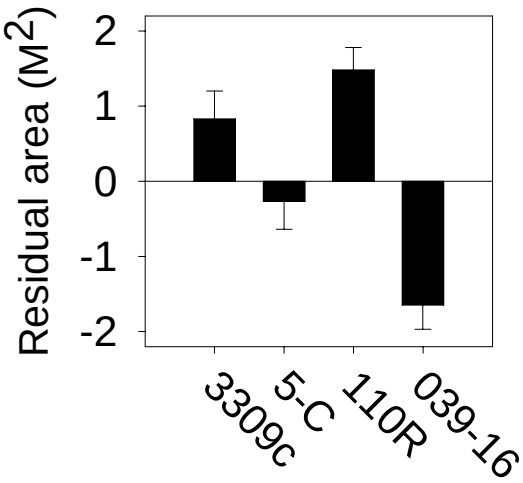


Q: Is average shoot length related to vine size (wt of prunings)?
A: No, it is related to the number of growing points.

Q: Are the rootstocks the same in this response?
A: No, with the same number of growing points on vines of the same size, 110R and 3309C will grow more, while 5C and O39-16 will grow less







Q: Do large vines have more leaf area?
A: Yes, but it more complicated than that (note the scatter around the line)

Q: Is leaf area affected by pruning formula (buds/wt of prunings).
A: No, it just shifts it from fewer longer shoots to more shorter shoots

Q: Is leaf area affected by rootstock?
A: Rootstocks (eg. 110R) would be classified as “more vigorous,”
i.e. have more leaf area.

Conclusions

- Vine Balance
  - Balance is best achieved by vineyard design
    - *We don't know as much about this as we should*
    - *Opinion: We are at a greater risk of planting vines too closely than too far apart*
  - *Pruning is not one of the practices to achieve balance*
    - *When growth is too great: excessive shoot growth and shading will result*
    - *When growth is too little: shoot numbers (= clusters) will be reduced, affecting yield per acre.*
  - Annual practices can be tools to achieve balance
    - *Requires inputs that can be costly*

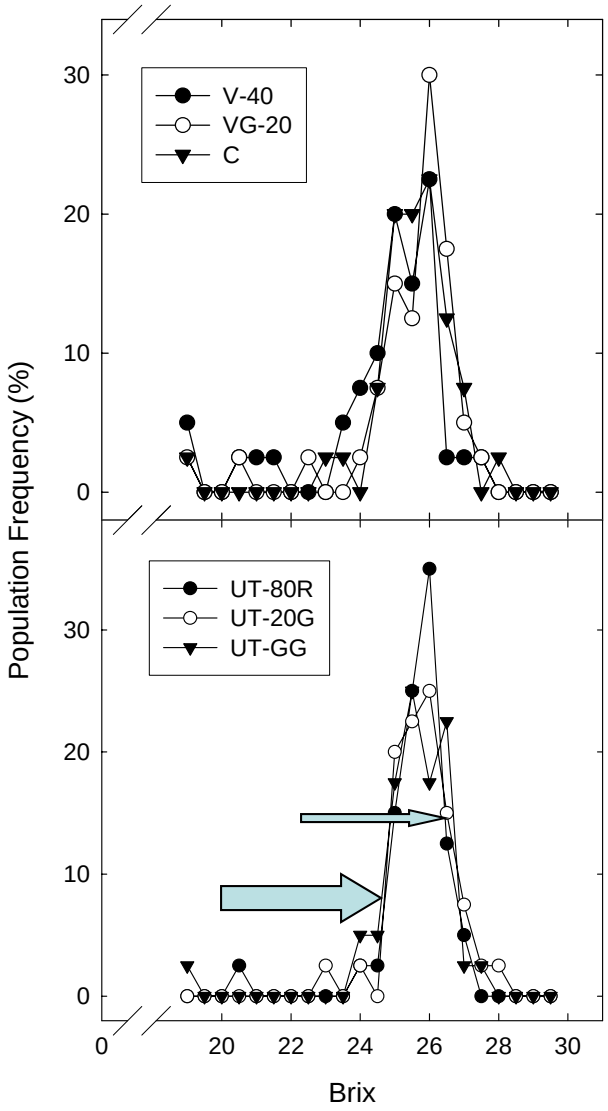
Fruit Thinning

- Common practice:
  - At 80% Veraison, remove the final 20% green clusters
- Presumption:
  - Clusters behind in ripening, remain behind throughout ripening

Experiment

Treatment	Timing	Cluster Thinning treatment	Clusters
UT-80R	80% Veraison	retained	reddest 80%
UT-20G	80% Veraison	retained and tagged	greenest 20%

Conclusion: Clusters that are the last to undergo color change at veraison do not remain less ripe when harvested at high maturity levels



Fruit Thinning

- Conclusions
  - Practice of late harvest, at high ripeness levels, may change our thinning practice
  - Need confirmation of the effect (only 2 yrs data)
  - Fruit ripening variability needs to be better understood

Questions?

- Thanks for your attention.