Annual Vegetative and Reproductive Cycles of Grapevines

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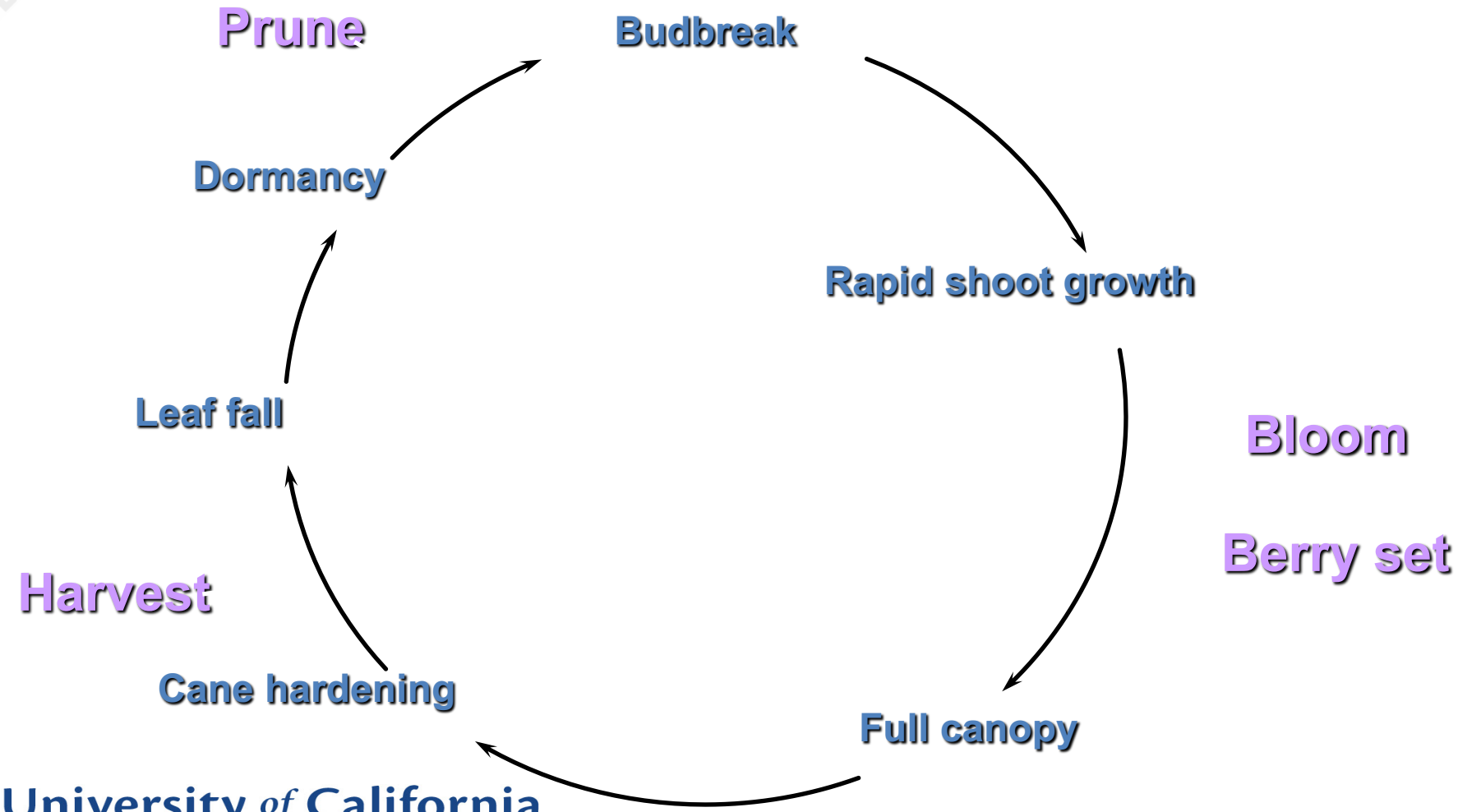
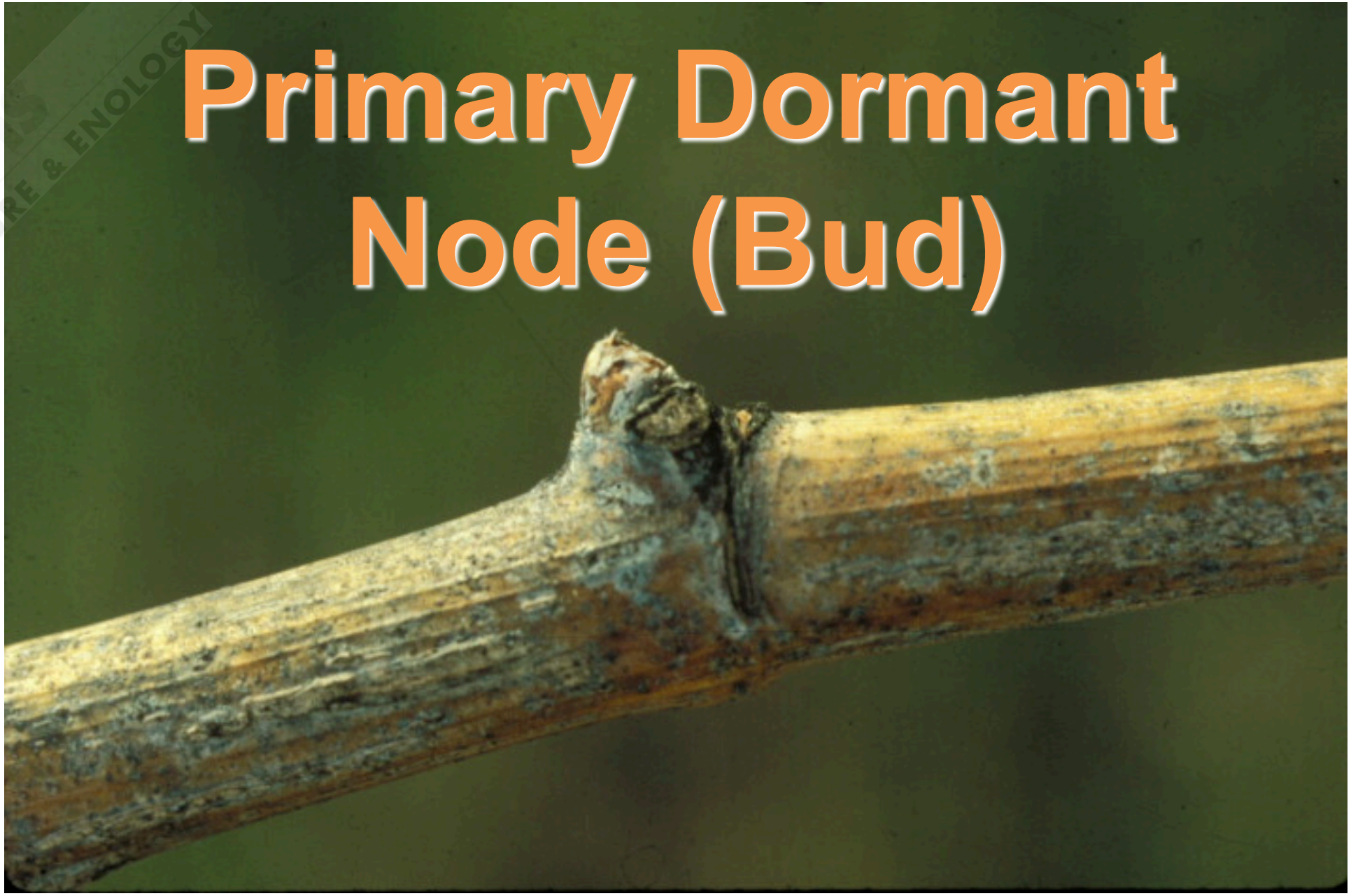
Overview of talk

- Introduce three integrated annual cycles
  - Vegetative growth
  - Cluster initiation
  - Fruit growth and development
- Demonstrate how the environment and cultural practices may affect these cycles, and thereby affect fruit yield and quality

Vegetative Growth Cycle




Primary Dormant
Node (Bud)

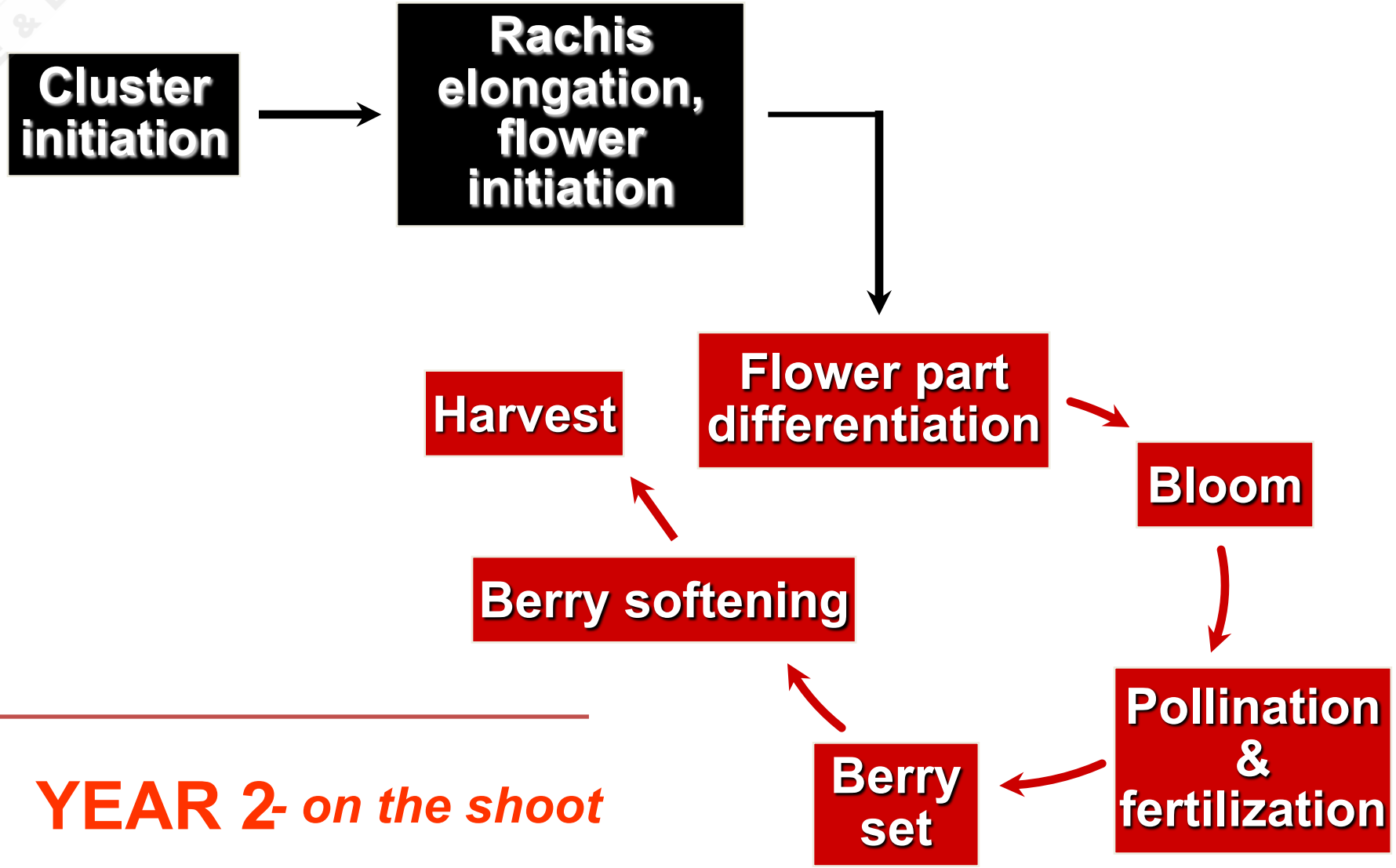

Lateral Bud
(Prompt Bud)


25

Reproductive cycle

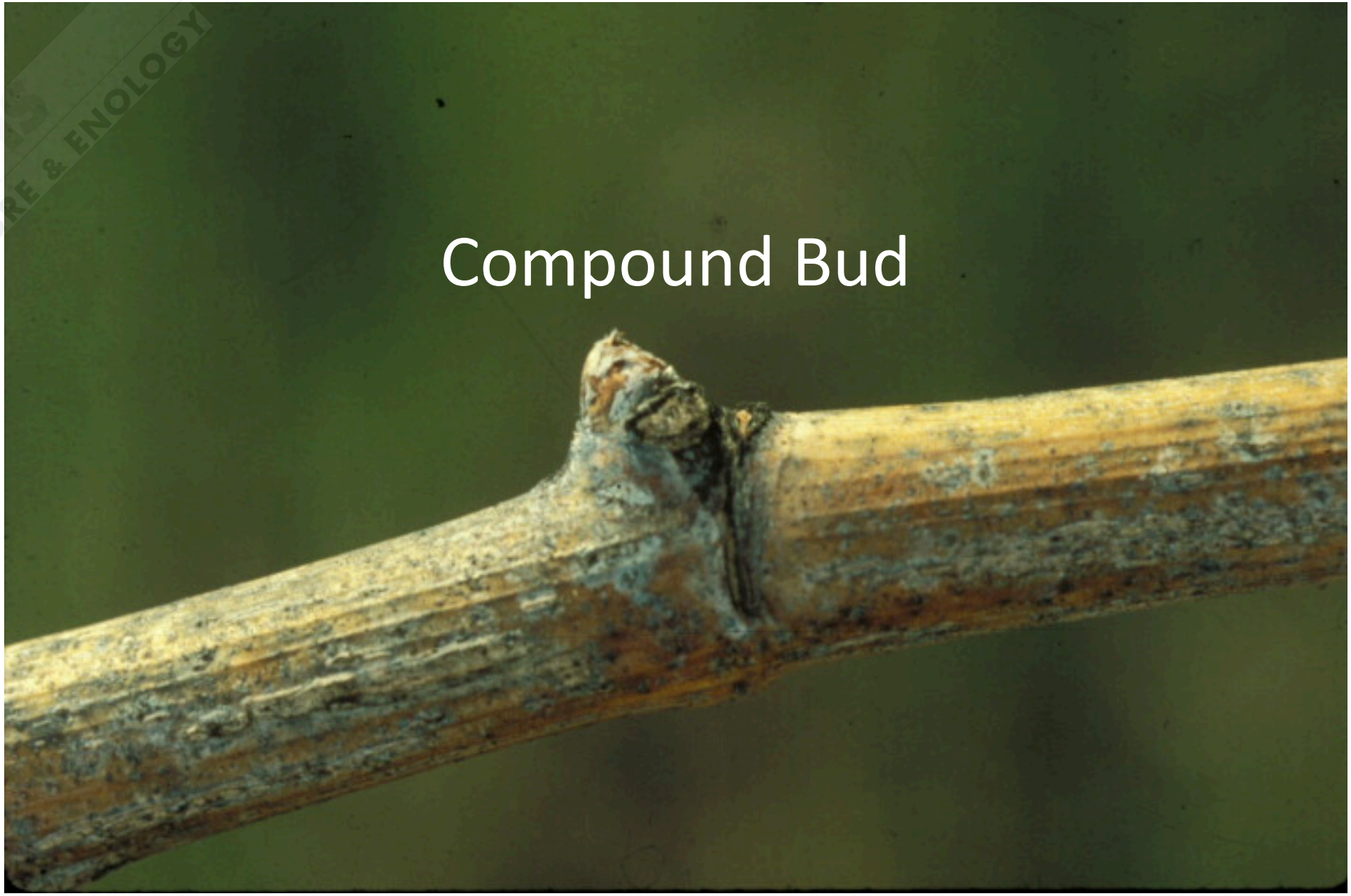
- Two-year process
  - Year 1: Flower clusters initiated and partially developed on microscopic pre-formed shoots within buds on green growing shoots.
  - Year 2: The pre-formed shoots emerge from dormant buds, flowers finish development, and bloom, fruit set, berry growth and maturation occur.

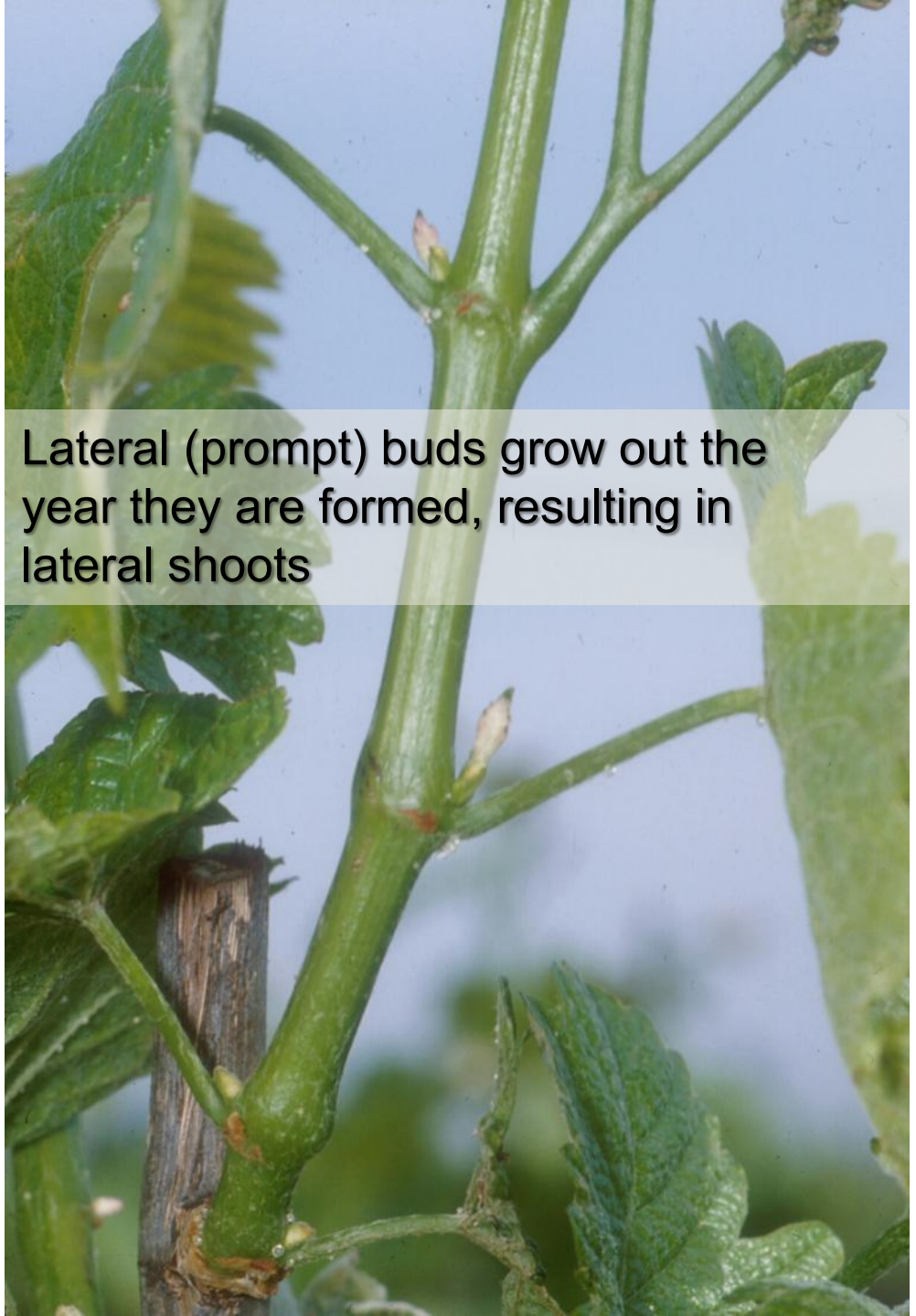
YEAR 1- *in the developing primary bud*



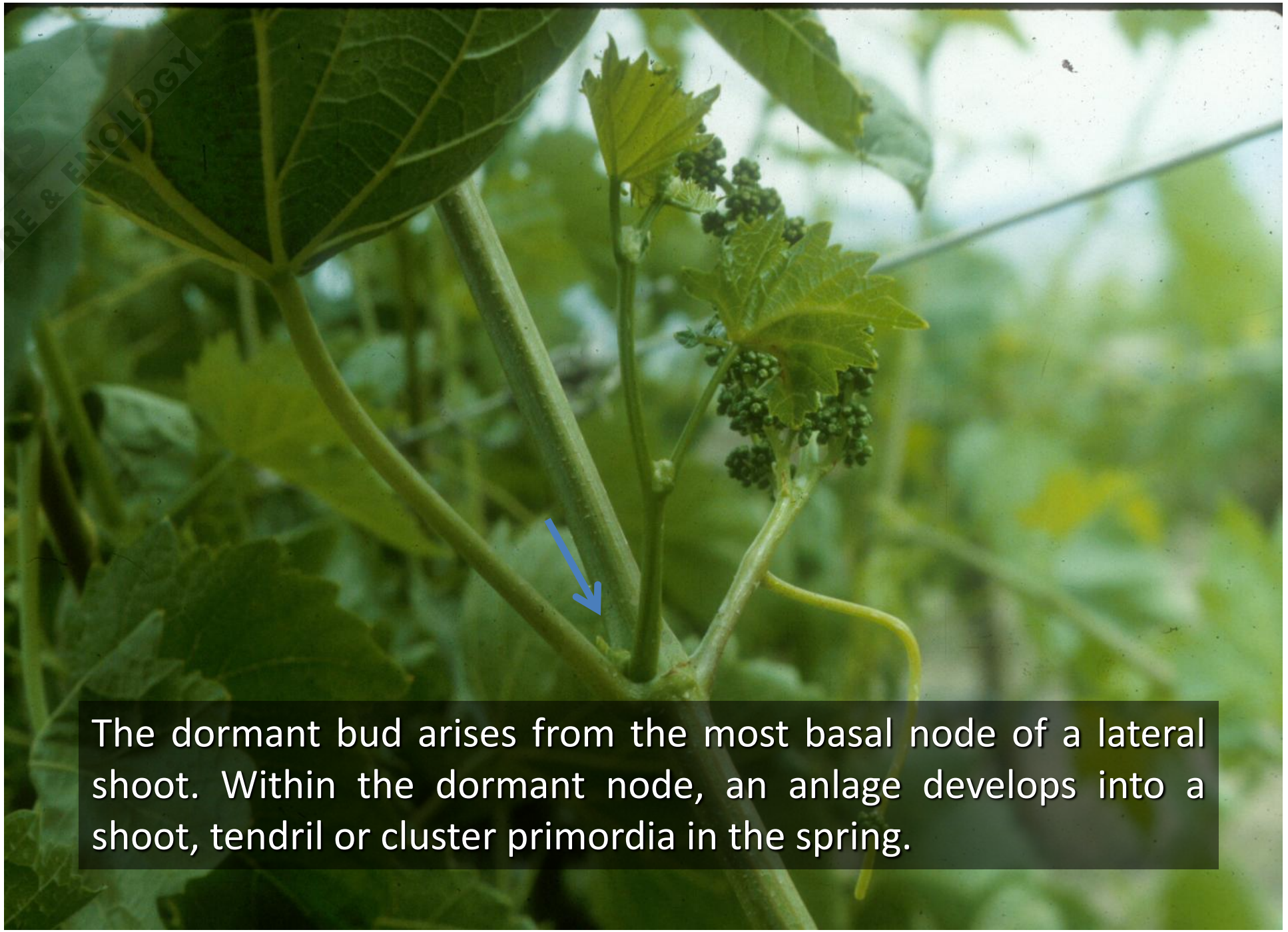
YEAR 2- *on the shoot*

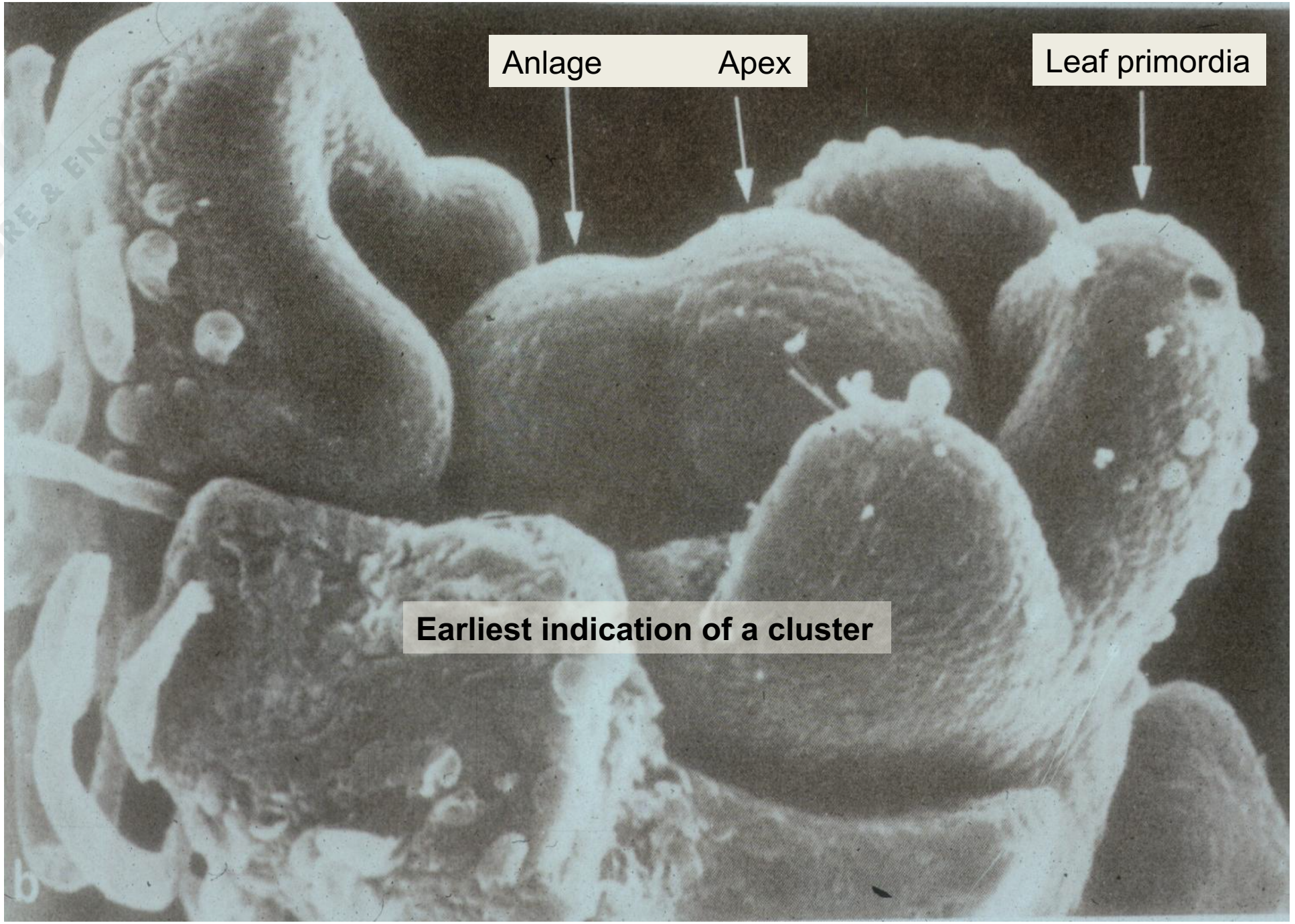
YEAR 1


Compound Bud



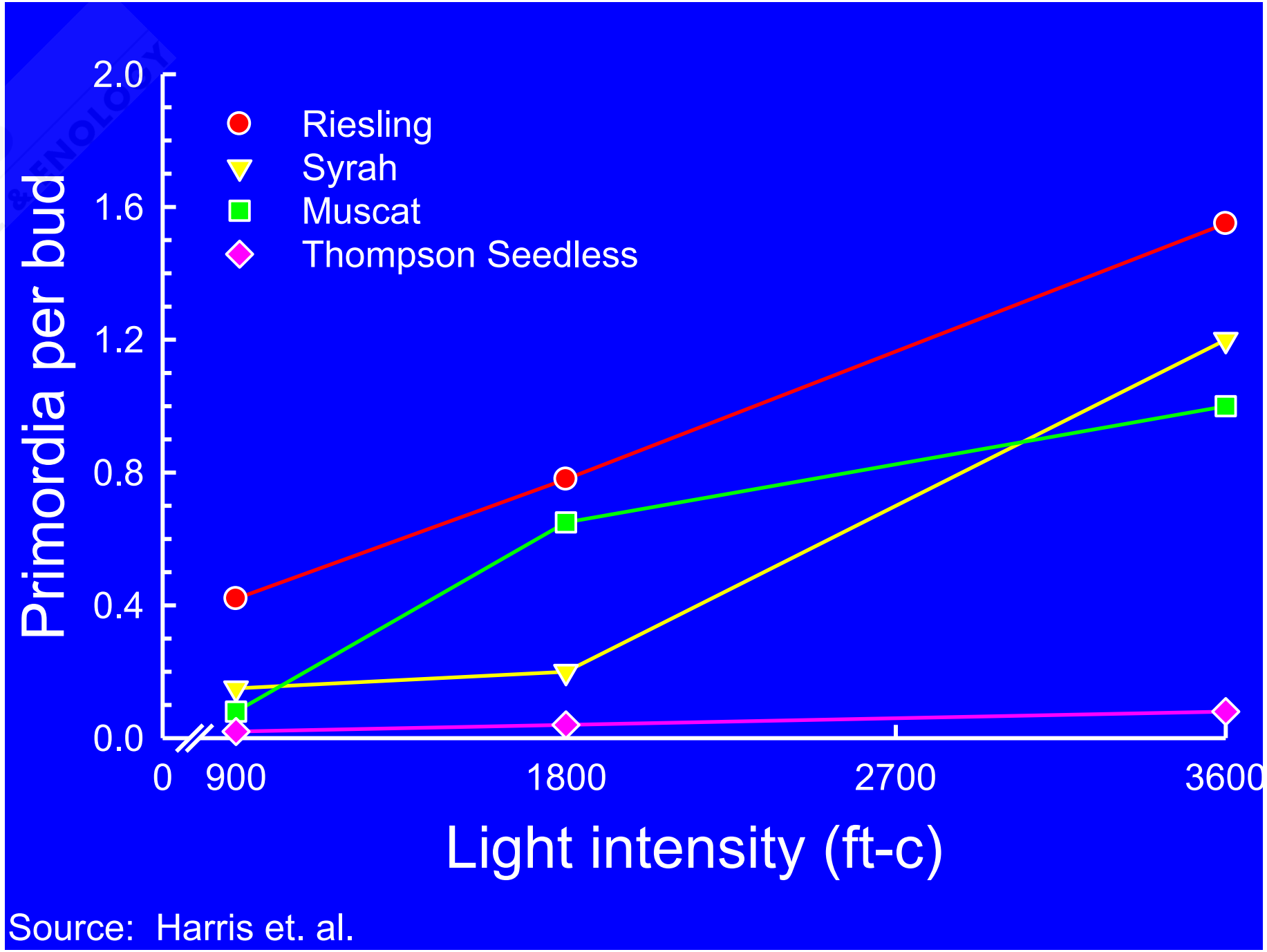
Lateral (prompt) buds grow out the year they are formed, resulting in lateral shoots


The dormant bud arises from the most basal node of a lateral shoot. Within the dormant node, an anlage develops into a shoot, tendril or cluster primordia in the spring.

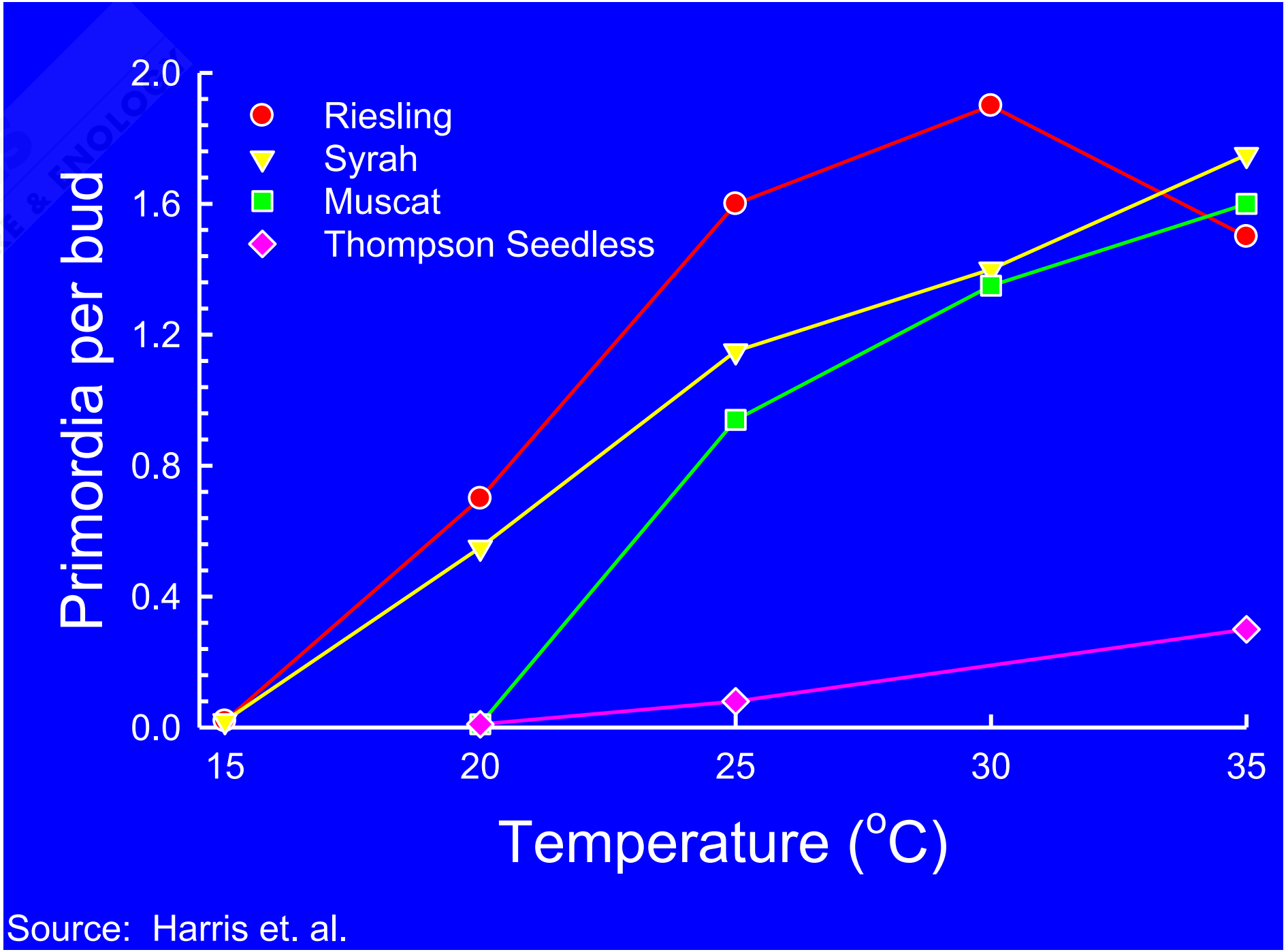

Anlage
Apex
Leaf primordia
Earliest indication of a cluster
b

Environmental Regulation of Bud Fruitfulness

- Light
- Temperature



Source: Harris et. al.



Source: Harris et. al.

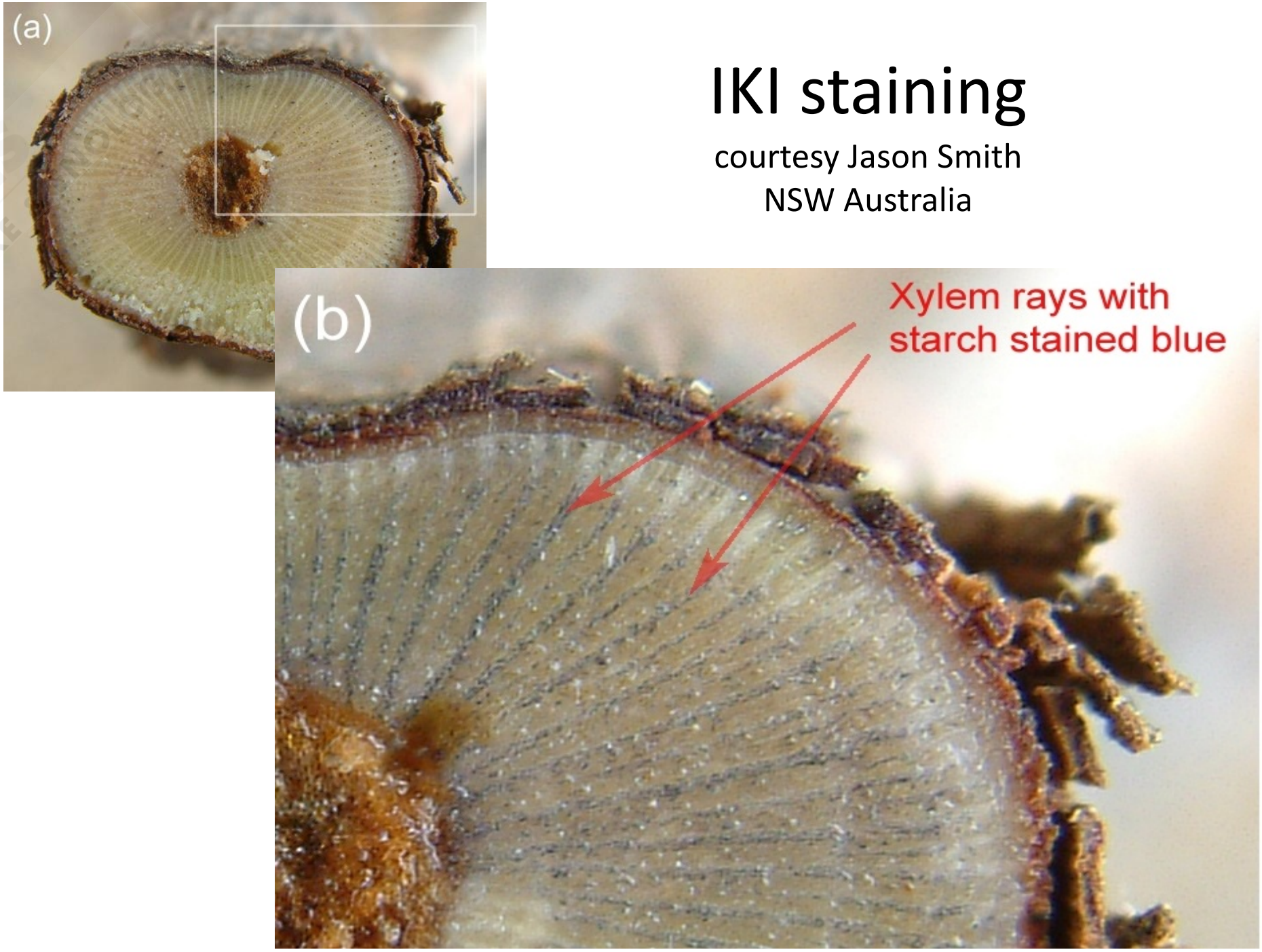
Thompson Seedless

Number of days of shading	Bud necrosis (%)	Bud fruitfulness (%)
0	43 b	44 a
15	73 a	19 b
30	69 a	23 b
45	74 a	21 b

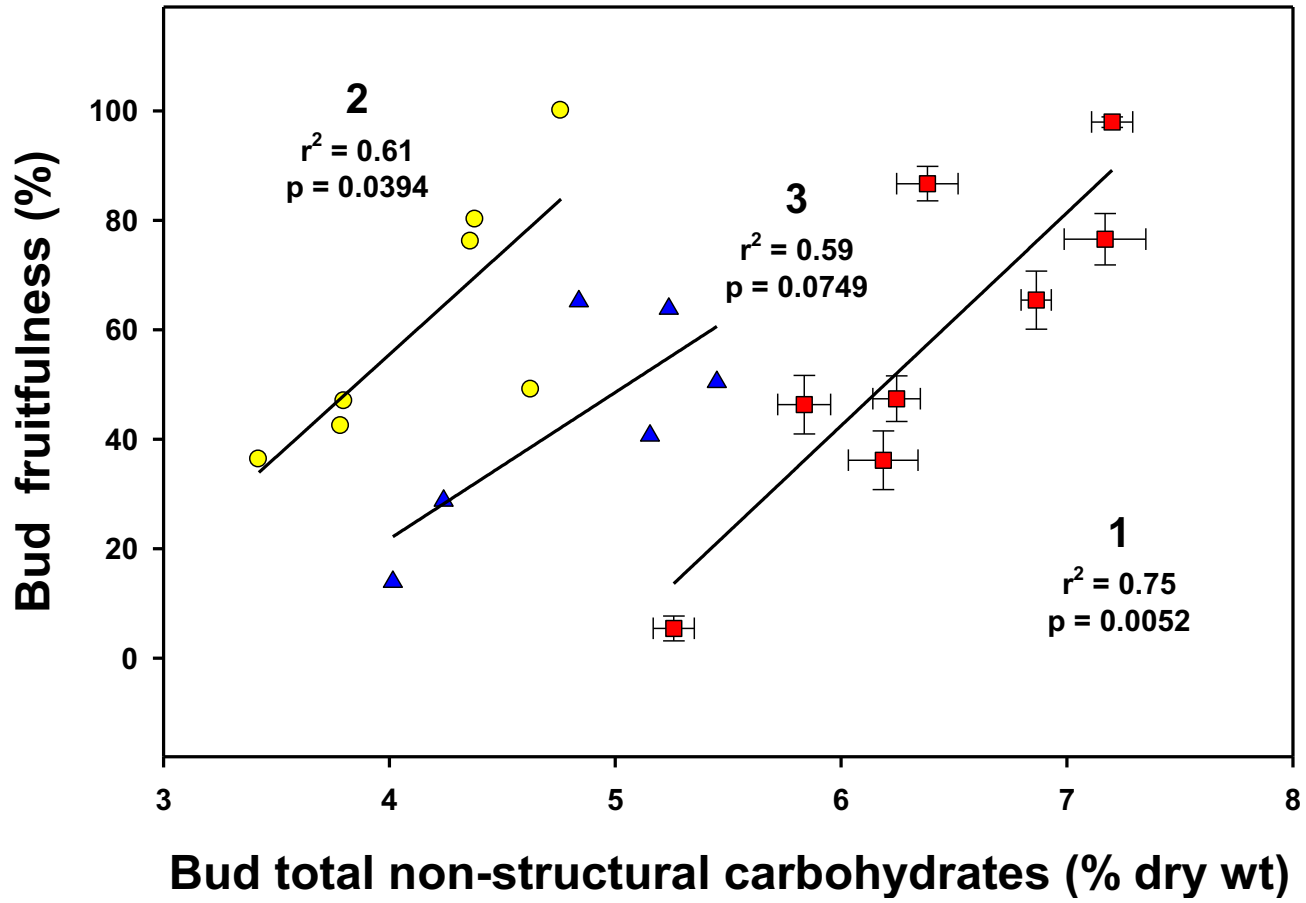
Perez and Kliewer (1990)

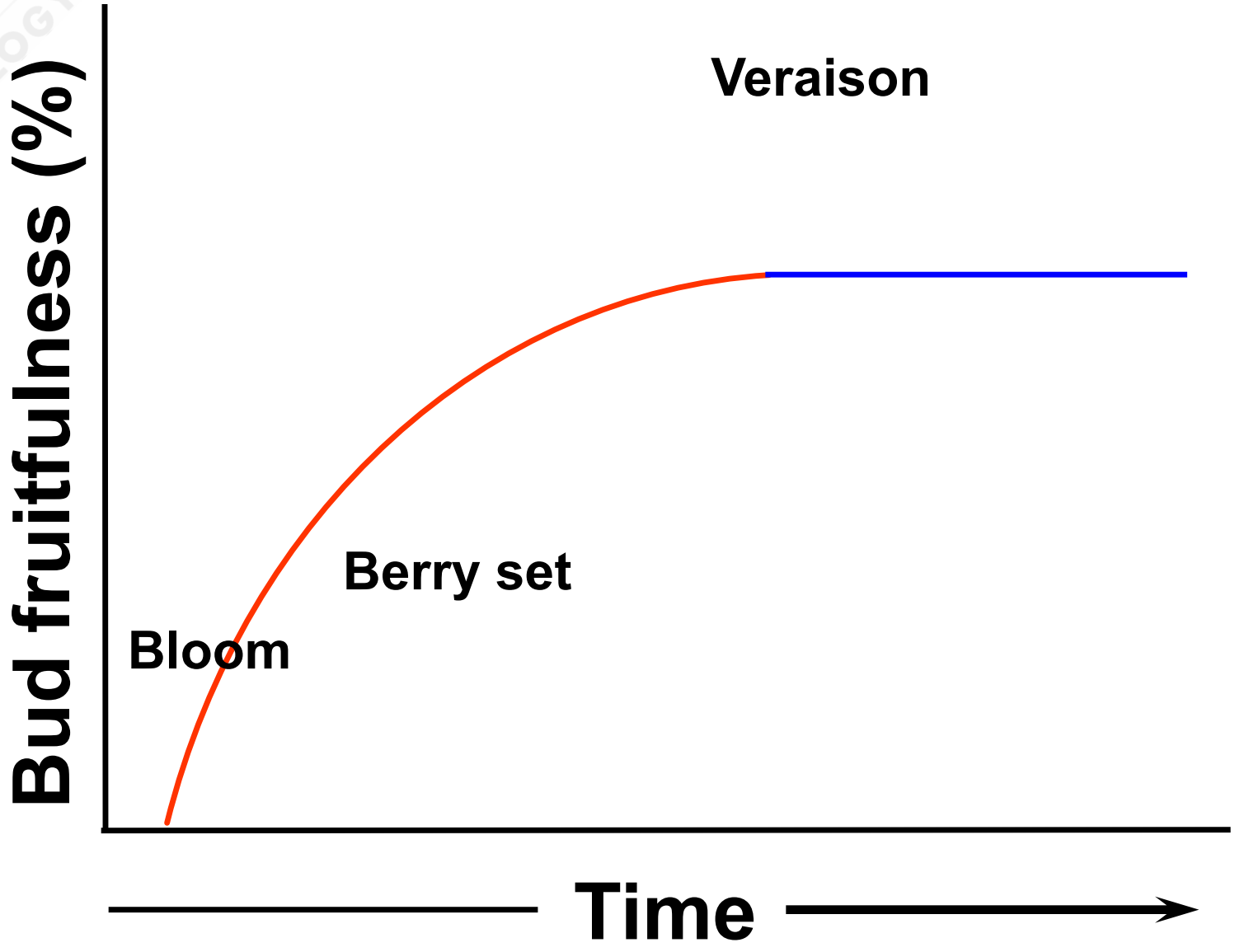
IKI staining

courtesy Jason Smith
NSW Australia



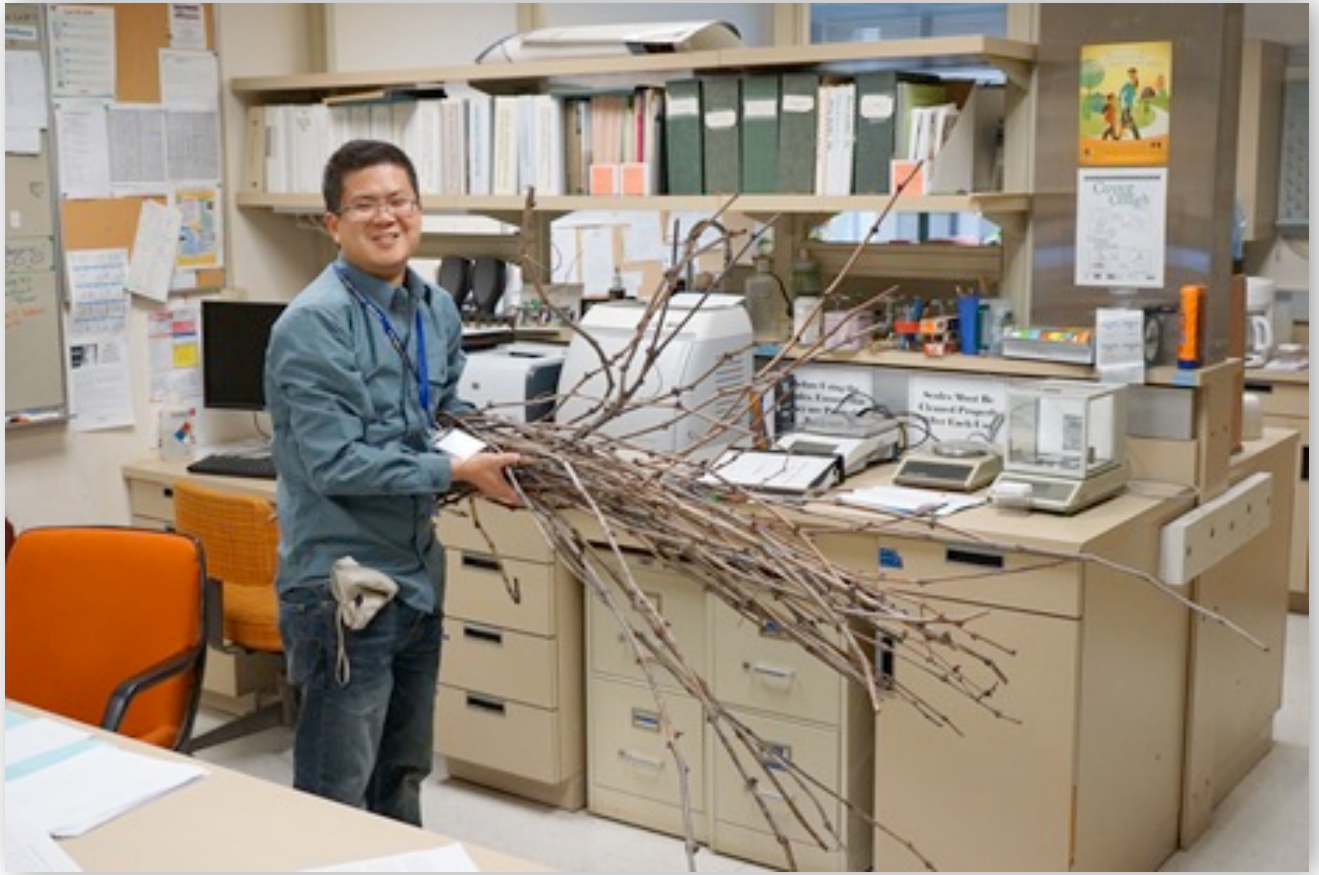
Thompson Seedless




Veraison
Bud fruitfulness (%)
Berry set
Bloom
Time

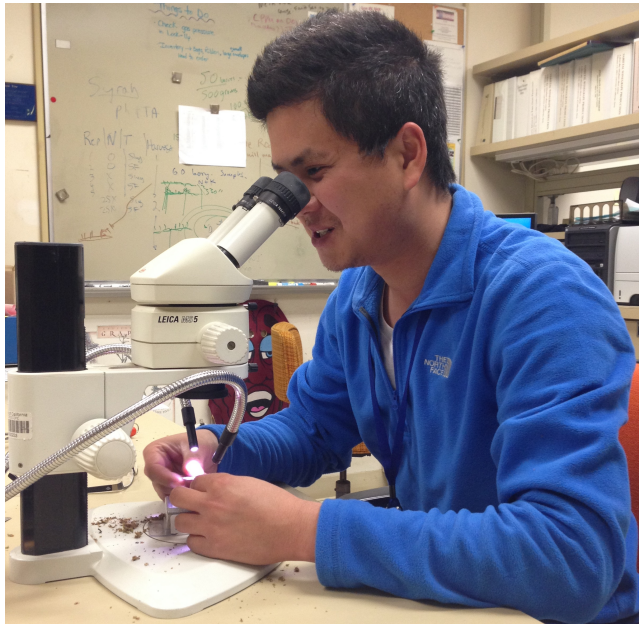

Compound Bud
By autumn, the number of clusters each
shoot could bear the following spring has been set

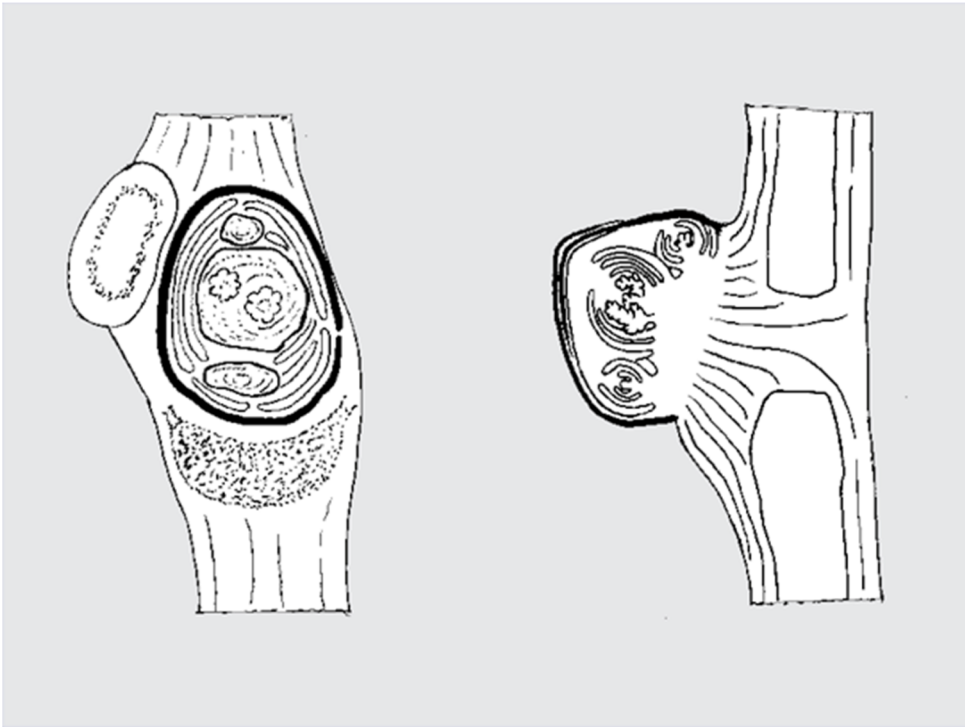
Bud dissections can inform pruning decisions



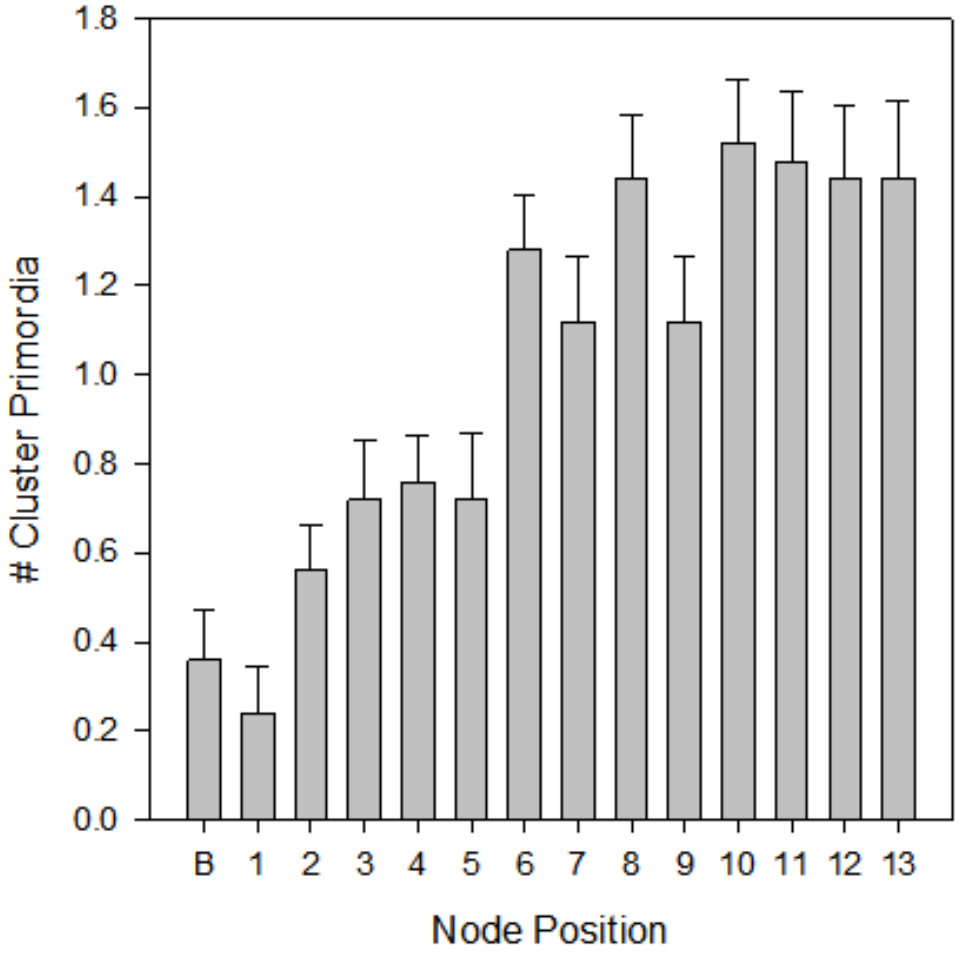
Estimation of Potential Yield

- Bud dissection to see the potential number of inflorescence primordia (Primary + Secondary)





Potential Bud Fruitfulness



Selma Pete, Kearney Ag Center, 2015, G. Zhuang


25

Sunlight promotes cluster initiation and development, and bud survival

- The number and potential size of clusters on preformed shoots is positively correlated with temperature, light, and carbohydrate accumulation in early summer, when clusters are initiated.

- Shading reduces cluster number and potential size, and promotes bud necrosis (death).

- Pruning: sun canes vs shade canes

Yield Components

- Clusters per vine
- Berries per cluster
- Berry weight
- Sugar per berry (raisin)

YEAR 2

Clusters initiated last spring will complete their growth this spring, as the preformed shoots emerge from the dormant nodes and growth to full size.

During this time cluster development can be directly affected by weather, insects, nutrition, and other factors.

Pollination


The number of berries/cluster and berry size will depend in part on pollination success. Grapes do not require insect pollination, but poor weather and mineral nutrient imbalances can substantially reduce set.

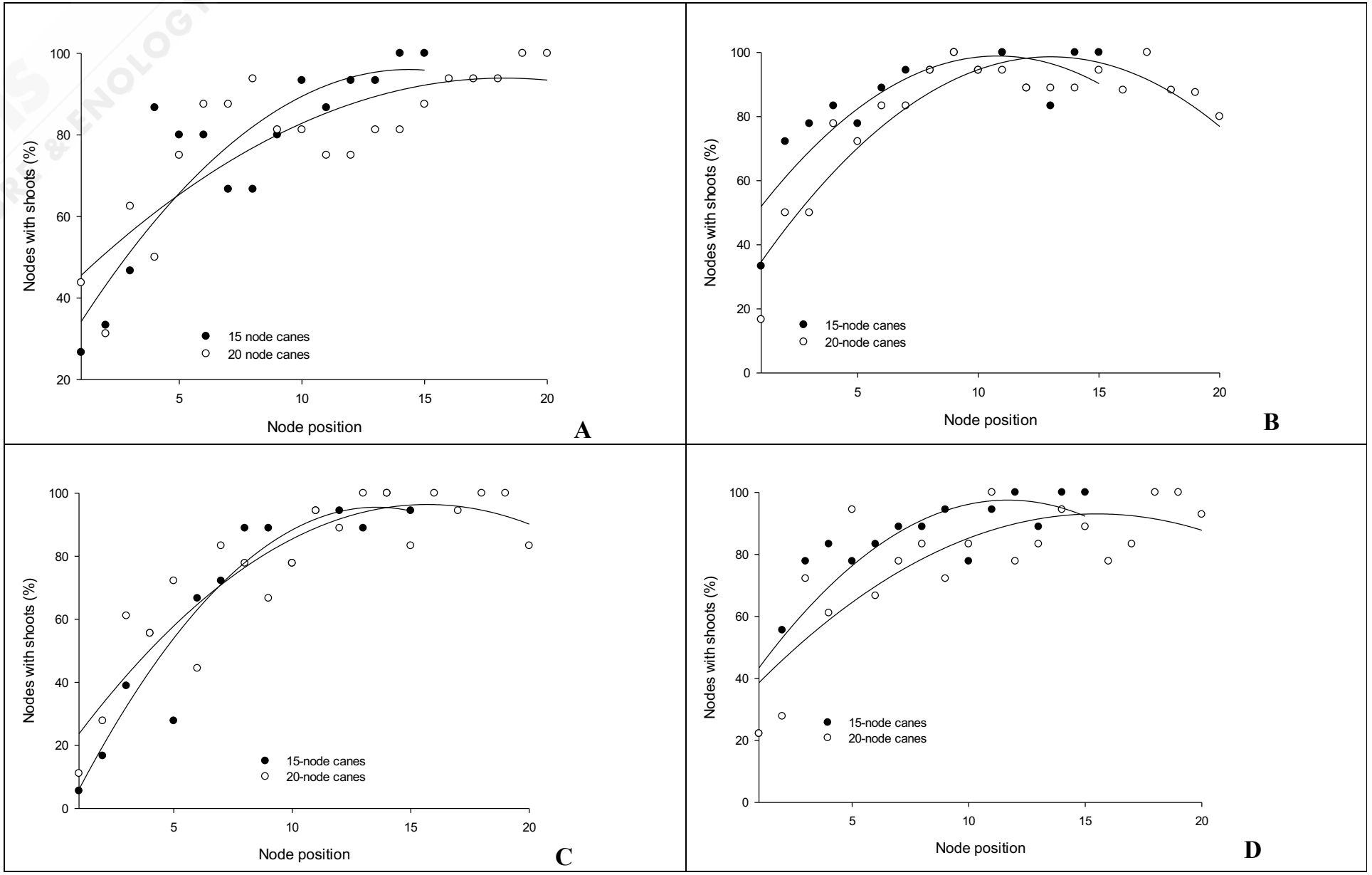
Zn application suggested 2 weeks prior to bloom

Further information

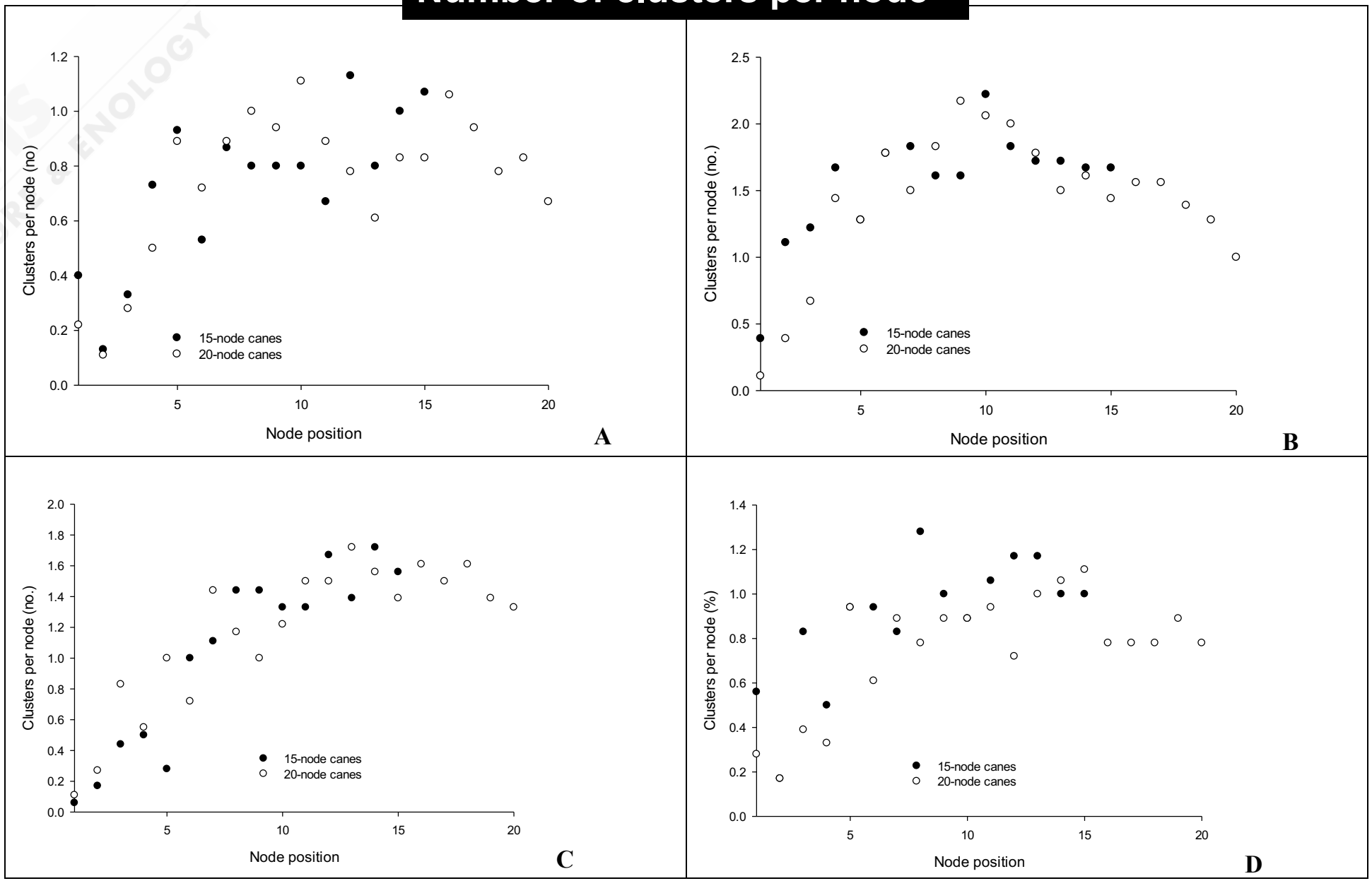
- http://www.slideshare.net/viticulture
- mwfidelibus@ucdavis.edu
- Twitter: @grapetweets

Cane length & node position affect yield components; raisin grape example

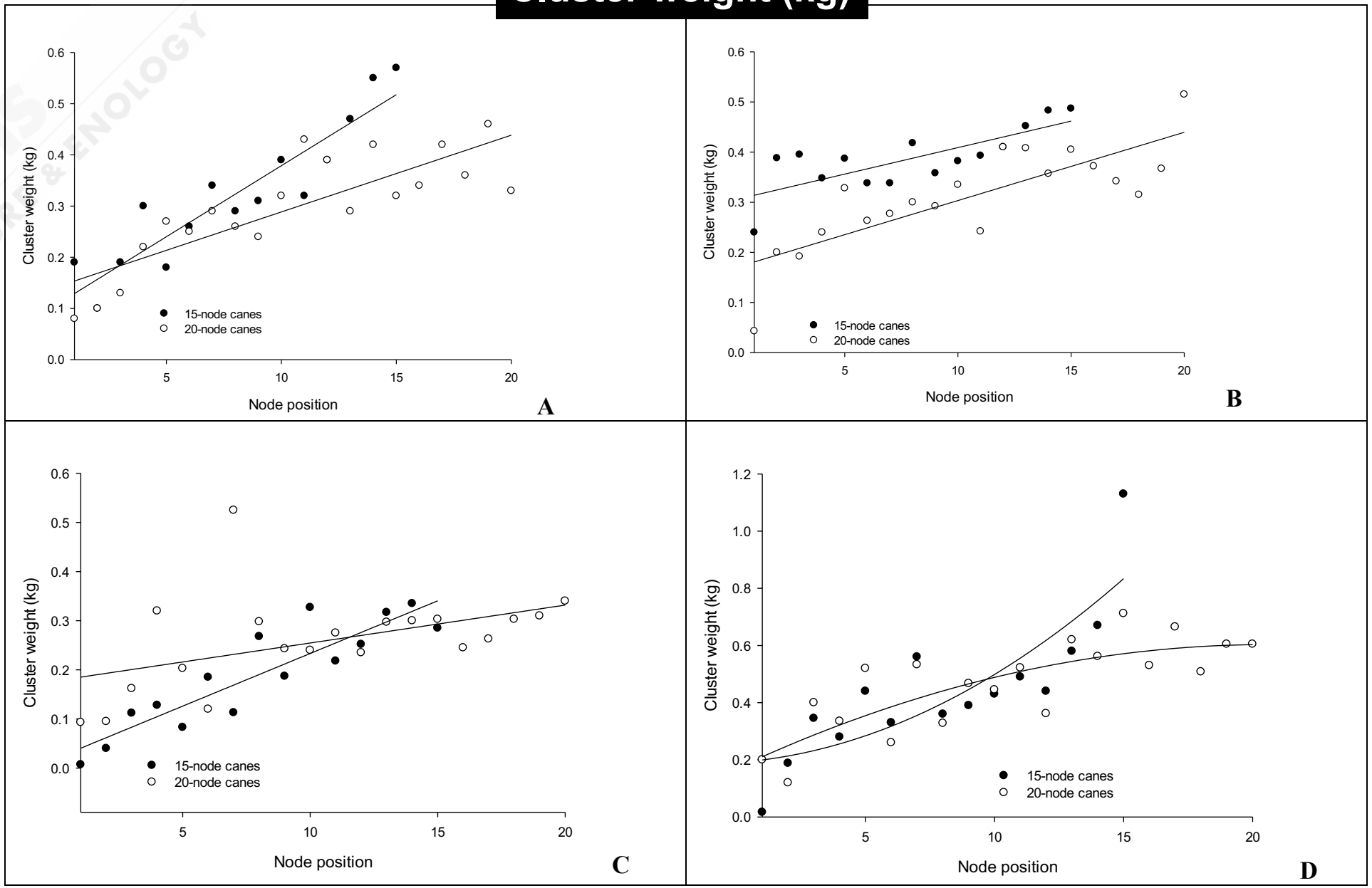
% Nodes with shoots



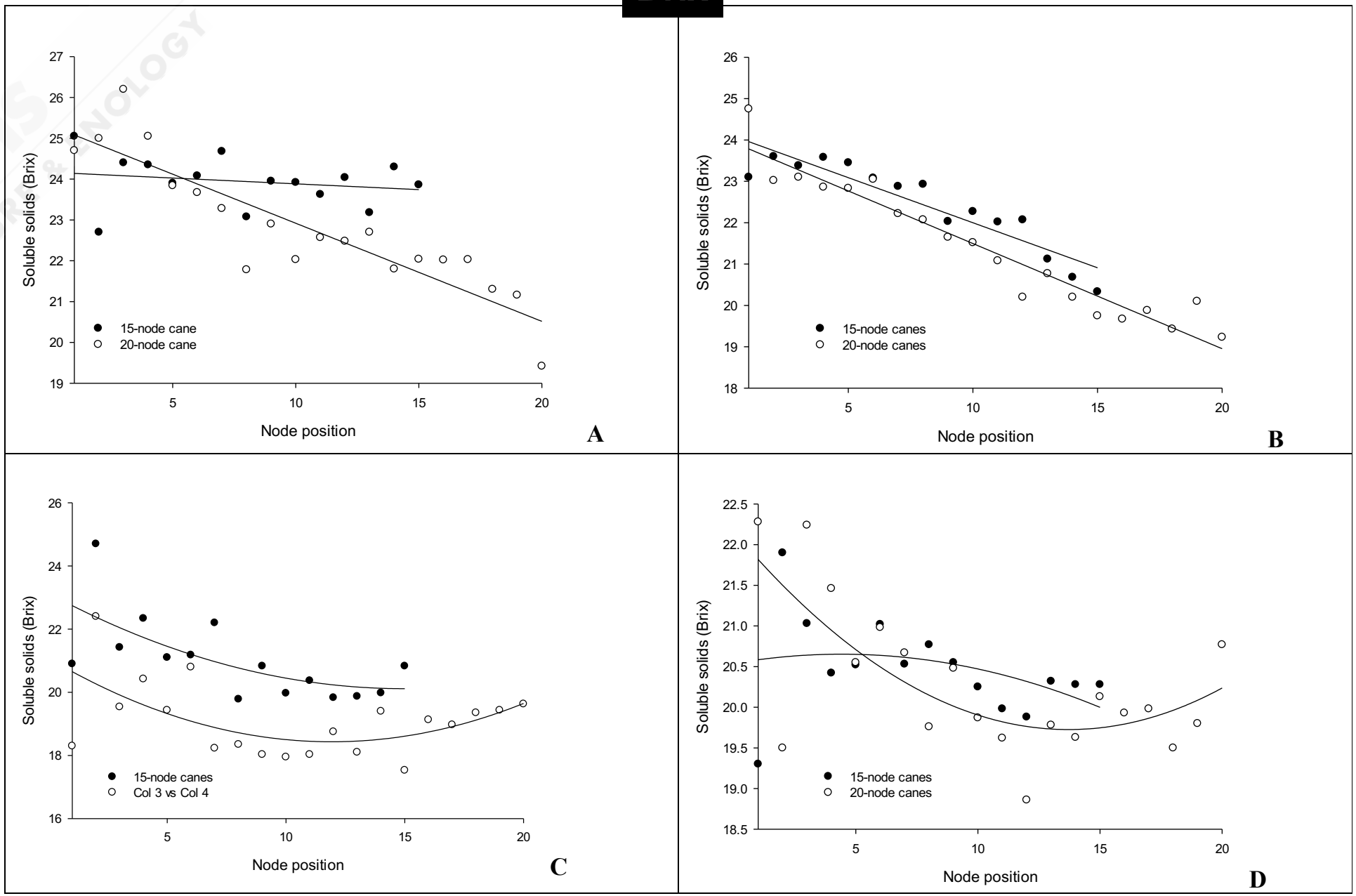
Number of clusters per node



Cluster weight (kg)



Brix

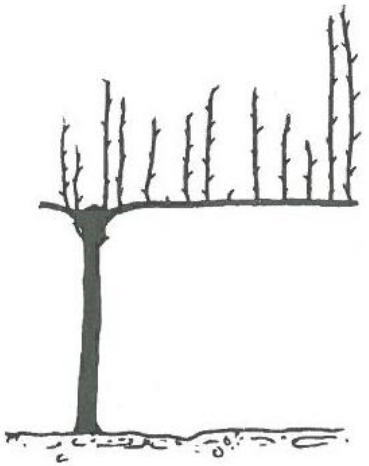

Soluble solids (Brix)
Node position
15-node cane
20-node cane
A
15-node canes
20-node canes
B
Col 3 vs Col 4
C
D

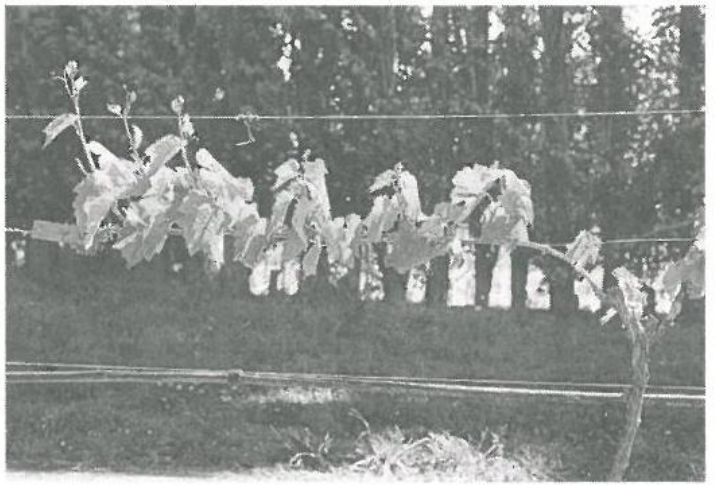
Some causes of blind buds on canes

- Cane length and node position (apical dominance, correlative inhibition, trunk proximity)
- Insufficient vine capacity (too many nodes left after pruning)
- Insufficient winter chill
- Overcropping, excessive water deficit stress, and/or excessive shading, in previous season

End-point principle

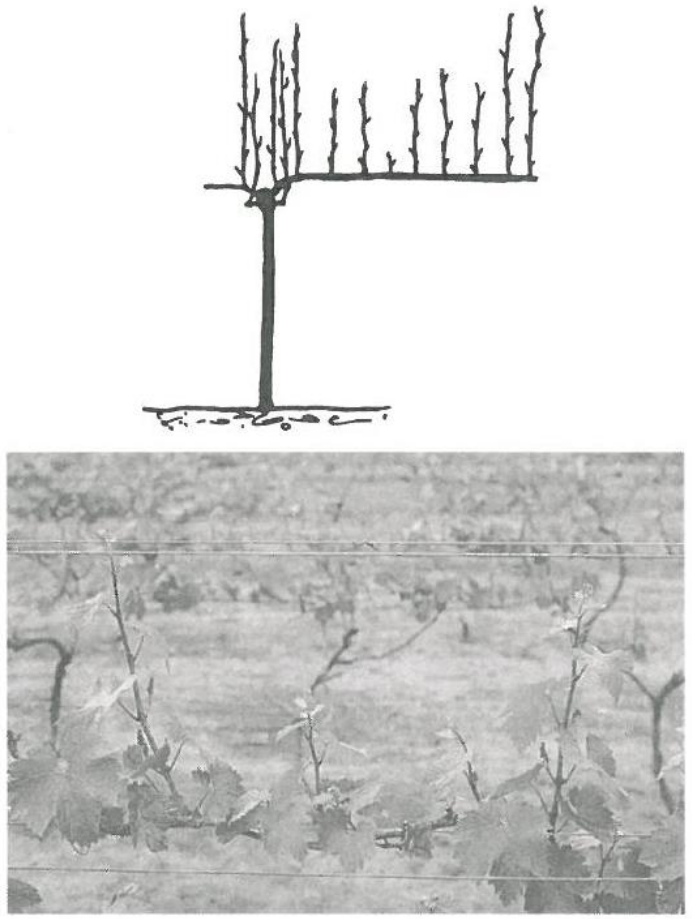
FIGURE 5: The End-Point Principle (EPP).





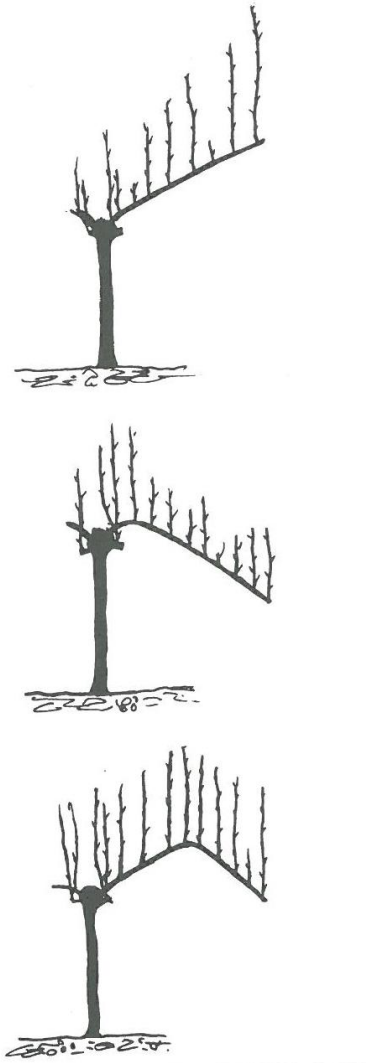
Trunk proximity principle (TPP)

FIGURE 6: The Trunk Proximity Principle (TPP).



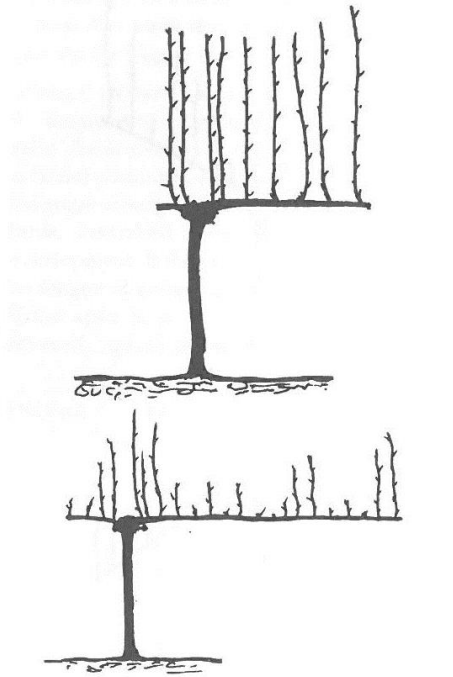
Highest point principal (HPP)

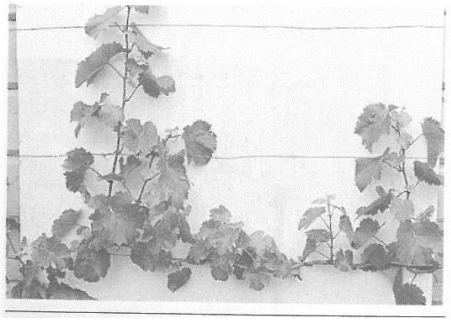
FIGURE 7: *Top and middle*: two examples of the Highest Point Principle. *Bottom*: an arched cane used to even out the EPP and TPP.



Root-shoot principle

FIGURE 8: The root-shoot principle. *Above*: heavily pruned vine—shoots tend to be more even in length. *Below*: lightly pruned vine (TPP left; EPP right).





Chilling hours

- Chilling promotes dormancy release, but requirement is relatively low; 50 to 400 hours < 45 F
- Can be difficult to determine if poor budbreak due to inadequate chill or correlative inhibition
- "…poor budburst in the mid-cane section of cane-pruned vines in cool maritime climates commonly attributed to lack of chill may be due to apical dominance"—The Grapevine, Iland et al., 2011

Historical accumulated chill hours

November 1 through February 28/29

			Hours < 45 F	Hours >32 F and <45 F
Sonoma	158	Bennett Valley	1016	915
	144	Petaluma East	1416	1253
	083	Santa Rosa	1007	861
	103	Windsor	1102	954

Improving budbreak

- Dormancy-breaking agents (e.g. Hydrogen cyanamide)
- Arching or “cracking” canes
- Conservative cropping & pruning
- Late season and postharvest irrigation
- Canopy management (sunlight exposure decreases bud necrosis, increases bud fruitfulness)

Acknowledgements

- Funding from the California Raisin Marketing Board
- L. Peter Christensen, Mike Moriyama, Steve Vasquez, several private growers

Presentation outline

- The annual cycle of vine growth & how it affects yield components
- Case study on the effects of node position on budbreak, fruitfulness, and fruit quality
- Causes of “blind” buds on cane pruned vines
- Practices that promote budbreak and shoot uniformity on canes