Vineyard Design

Spacing and Trellis Selection

Larry Bettiga
Viticulture Advisor
Monterey, Santa Cruz and San Benito Counties

UC CE | University of California
Agriculture and Natural Resources | Cooperative Extension

Spacing & Trellis Decision Goals

- High quality as defined by your market
- High productivity per acre
- Vineyard that is efficient to farm

Definitions

- **Vine vigor** is a measurement of the rate of vine growth.
- **Vine capacity** is the total annual vegetative and fruit biomass produced.
- **Vine size** is the annual vegetative growth

Capacity refers to the vine's ability for total production rather than rate of growth.

Factors Influencing Vigor

- Soil – depth, texture, water-holding capacity, fertility
- Climate
- Rootstock
- Variety
- Spacing
- Farming practices – irrigation, fertilization, site preparation, cover crops

Characteristics of the Ideal Wine Grape Canopy

Canopy Character	Optimal Value
Shoot density	~ 5 shoots per foot
Shoot length,	15 to 20 nodes
Lateral shoot development	None to very minimal
Growing shoot tip presence	Ideally none
Ratio of leaf area to fruit weight	3 to 8 ft^2/lb (0.6 to 1.5 m^2/kg)
Leaf layer number	1-2
Percent exterior leaves	80-100%
Percent exposed clusters	50 to 80%
Cane weight	0.7 to 1.4 oz (20 to 40 g)
Internode length	2.4 to 3.1 in 6 to 8 cm
Pruning weight	0.2 to 0.4 lb/ft (0.3 to 0.6 kg/m)
Ratio of crop weight to pruning weight	5-10

Adapted from Smart and Robinson 1991

SPACING

Vineyard spacing has 2 components:

- Row Spacing
- Vine Spacing

Row Spacing:

- Based on farming equipment
- Light Interception efficiency
- Operational efficiency

Vine Spacing:

- Based on anticipated vine vigor

Row Spacing

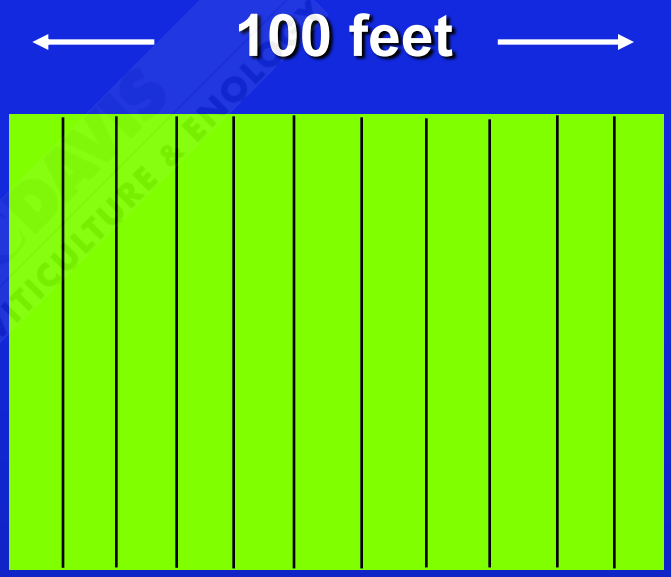
- What equipment will be going down the row?
- How wide is it?


12 Foot row width


5-foot row
width

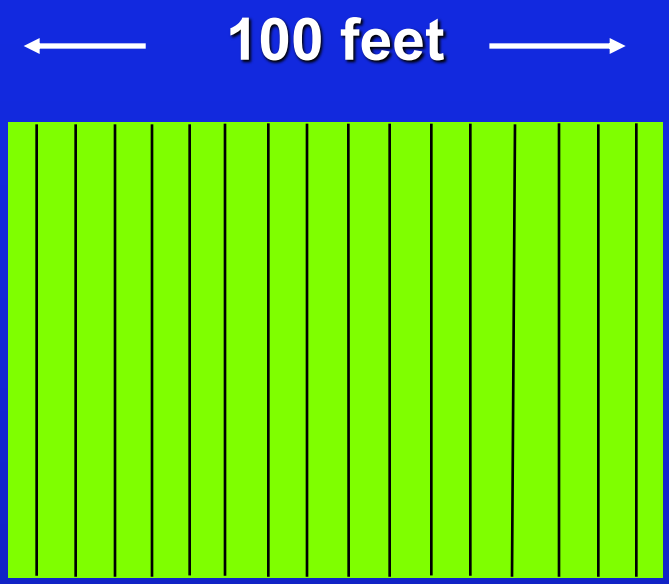

264
266
5 foot row width


TARE 495



Ten 9-foot rows

11 passes per tractor operation



Sixteen 6-foot rows

17 passes per tractor operation

60% more time for tractor work:
mowing, cultivation, spraying, dusting

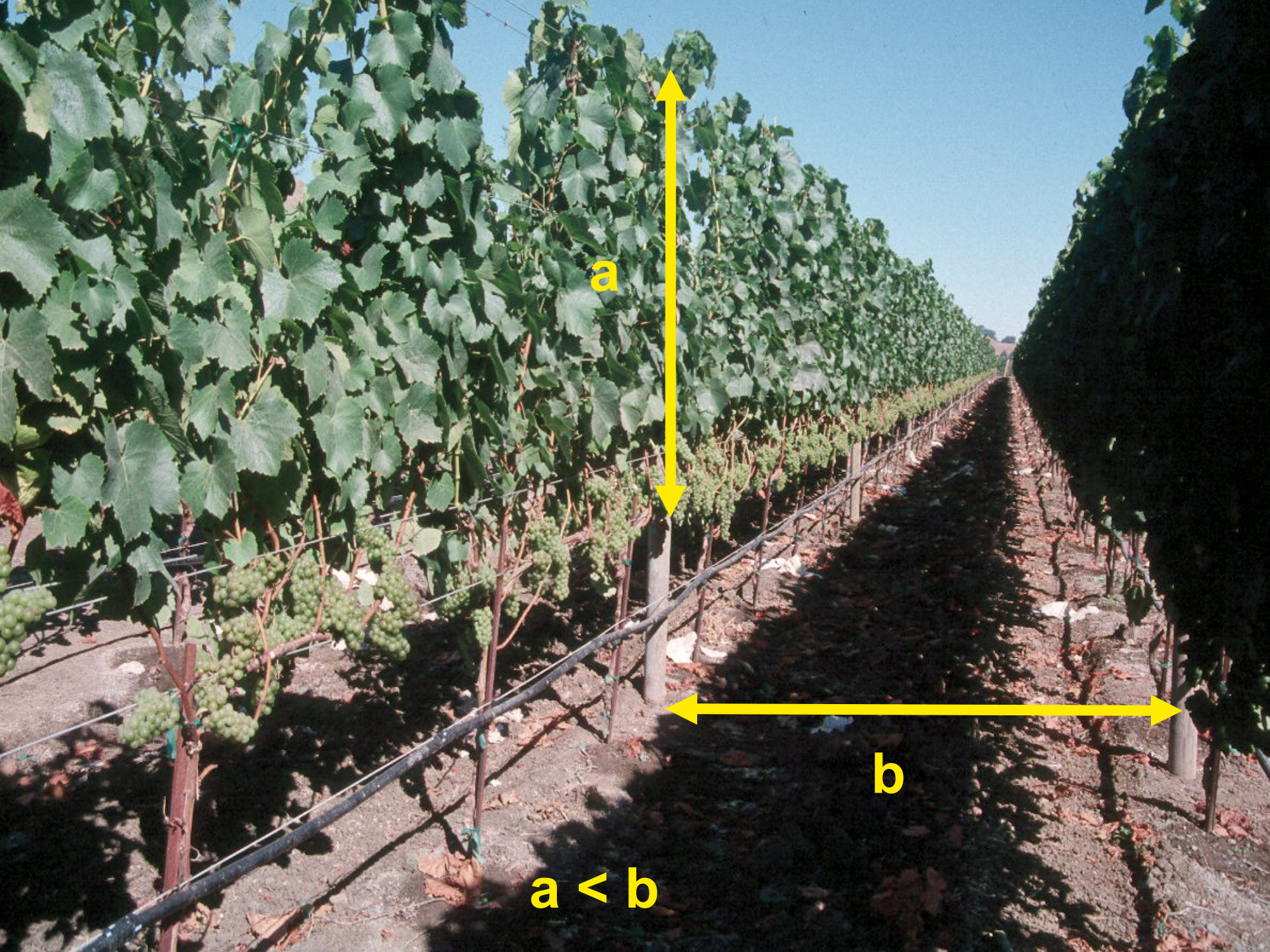
40-60% more time for hand vine care:
pruning, suckering, leaf removal, thinning...

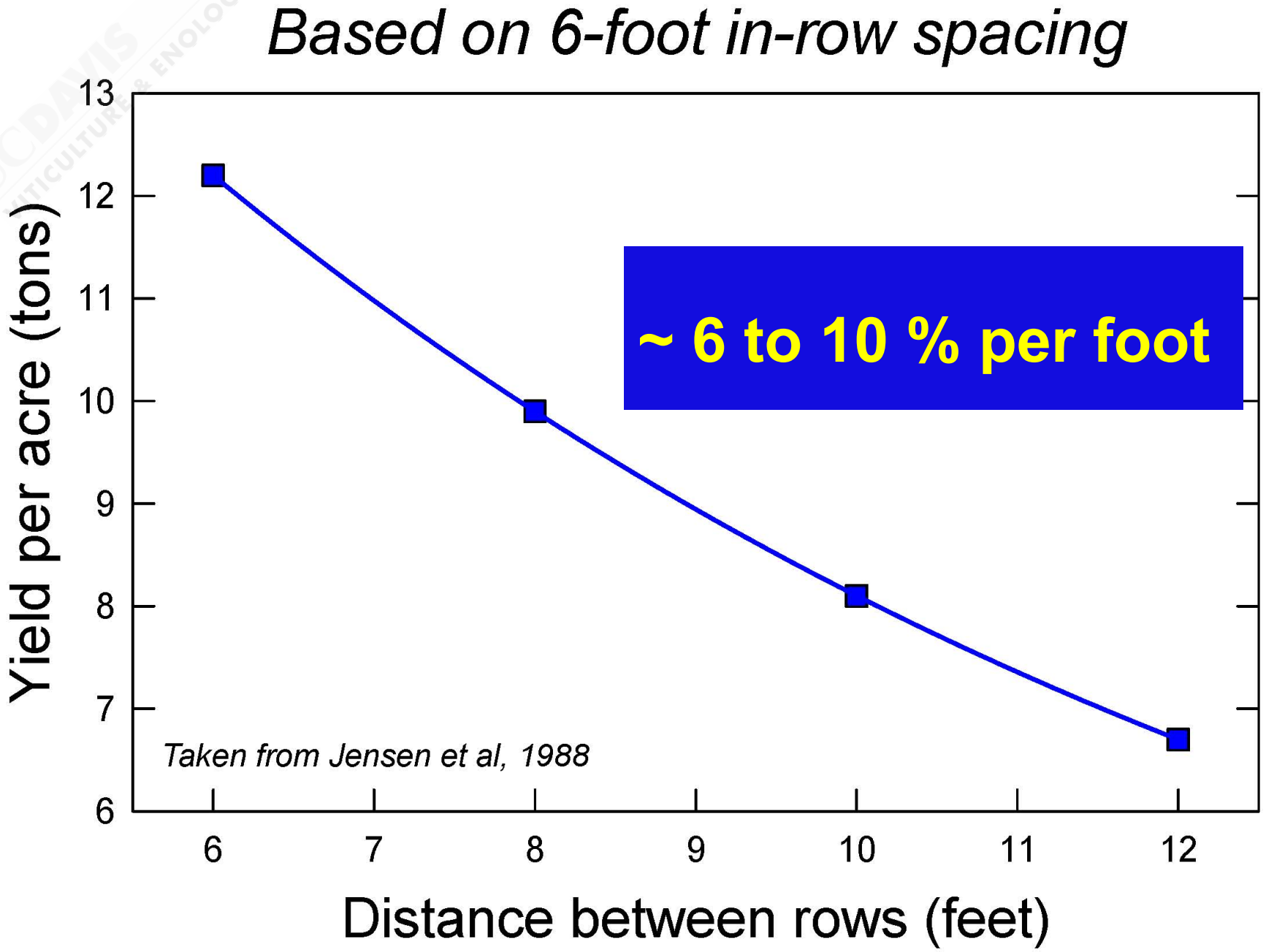

4 row sprayer

Light Interception efficiency

12 foot

6 foot


a
b
a < b


Based on 6-foot in-row spacing
Yield per acre (tons)
13
12
11
10
9
8
7
6
~ 6 to 10 % per foot
Taken from Jensen et al, 1988
6
7
8
9
10
11
12
Distance between rows (feet)

In-Row Vine Spacing

- Should be based on anticipated vine vigor.

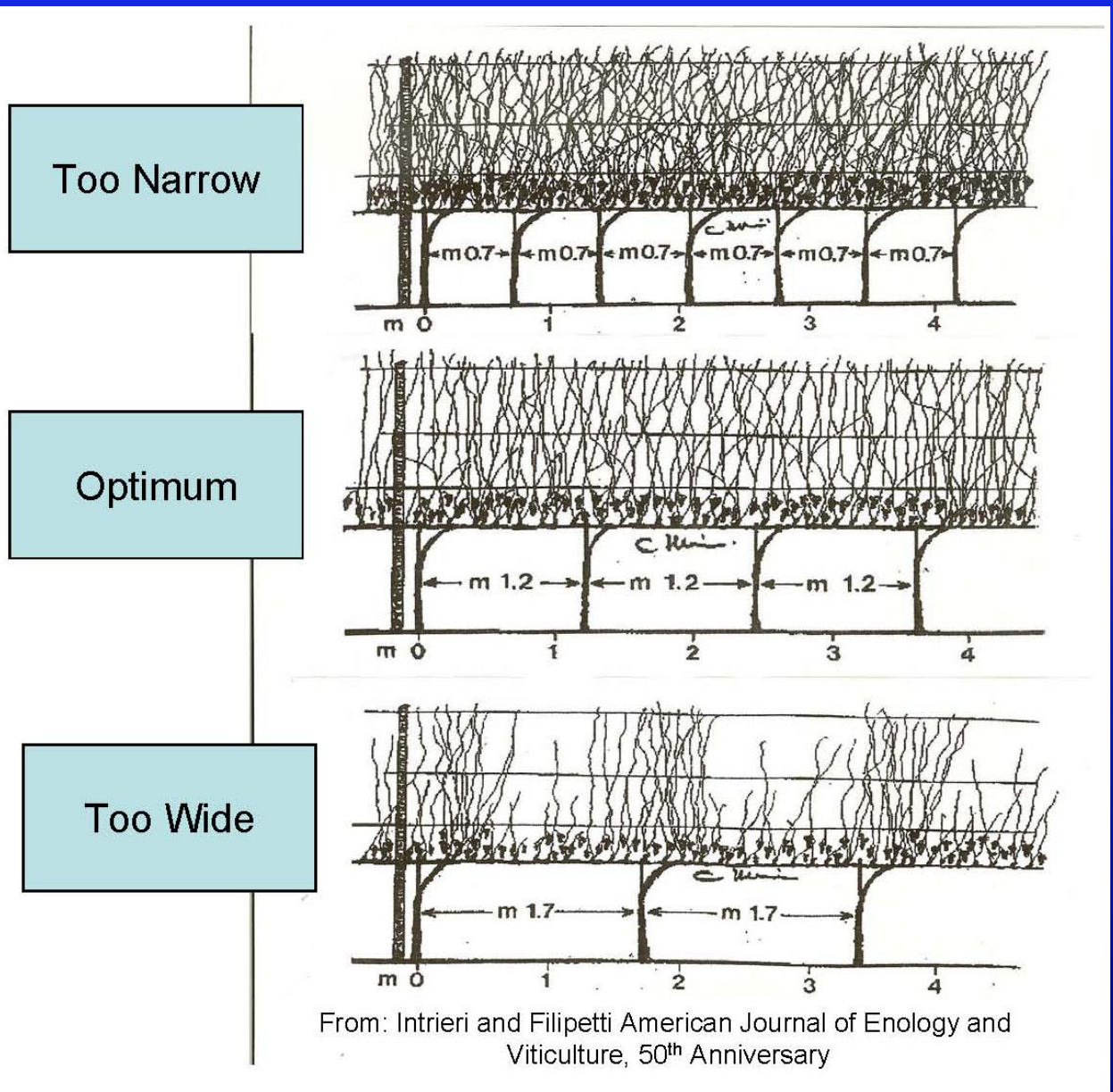
In-Row Vine Spacing

- Close enough together to produce a continuous fruit zone without gaps.

In-Row Vine Spacing

- Close enough together to produce a continuous fruit zone without gaps
- Far enough apart to provide space for enough buds to be left at pruning in order to balance the vine

Vine Spacing



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

8 x 10 spacing, 66 in high cordon

Planting Density

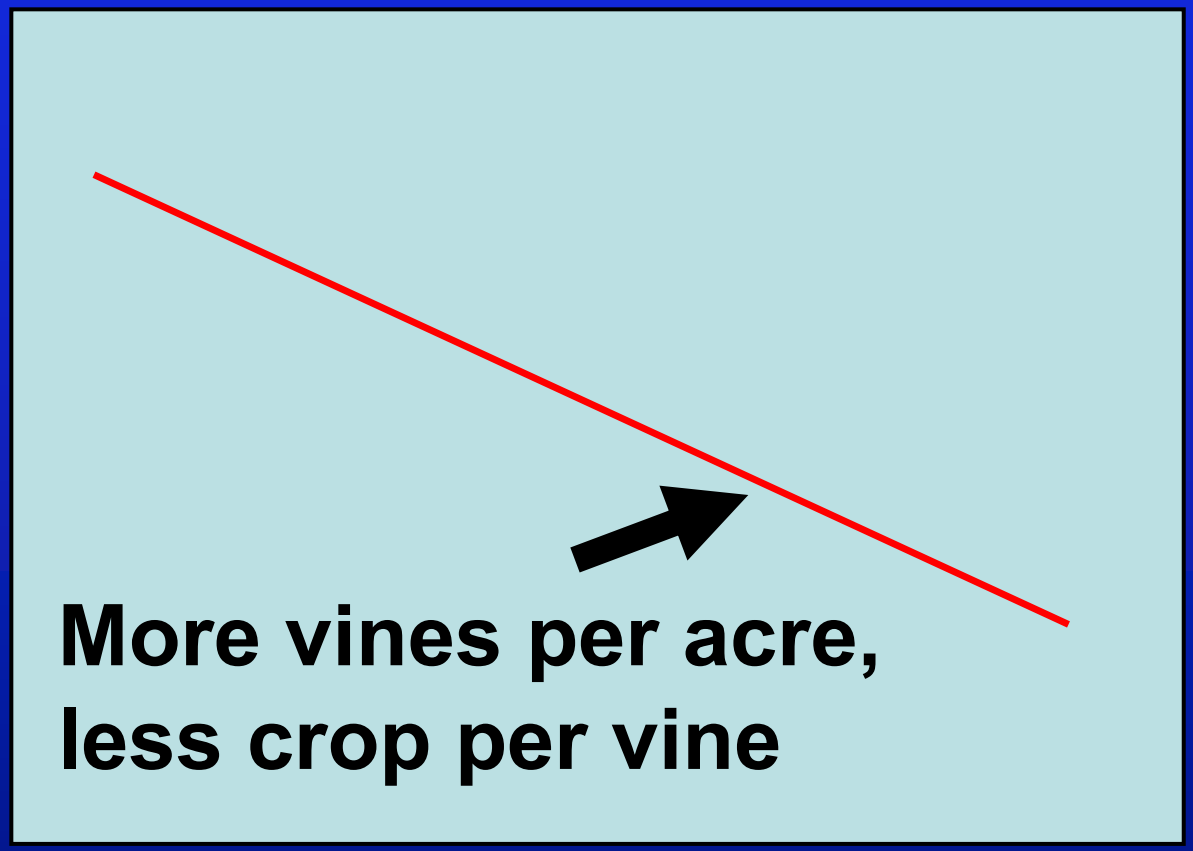
 # vines/acre = 43,560/row spacing (ft) X vine spacing (ft)

Spacing (ft)	Vines per acre
8 x 12	454
6 x 12	605
4 x 12	908
8 x 8	681
6 x 8	908
4 x 8	1361

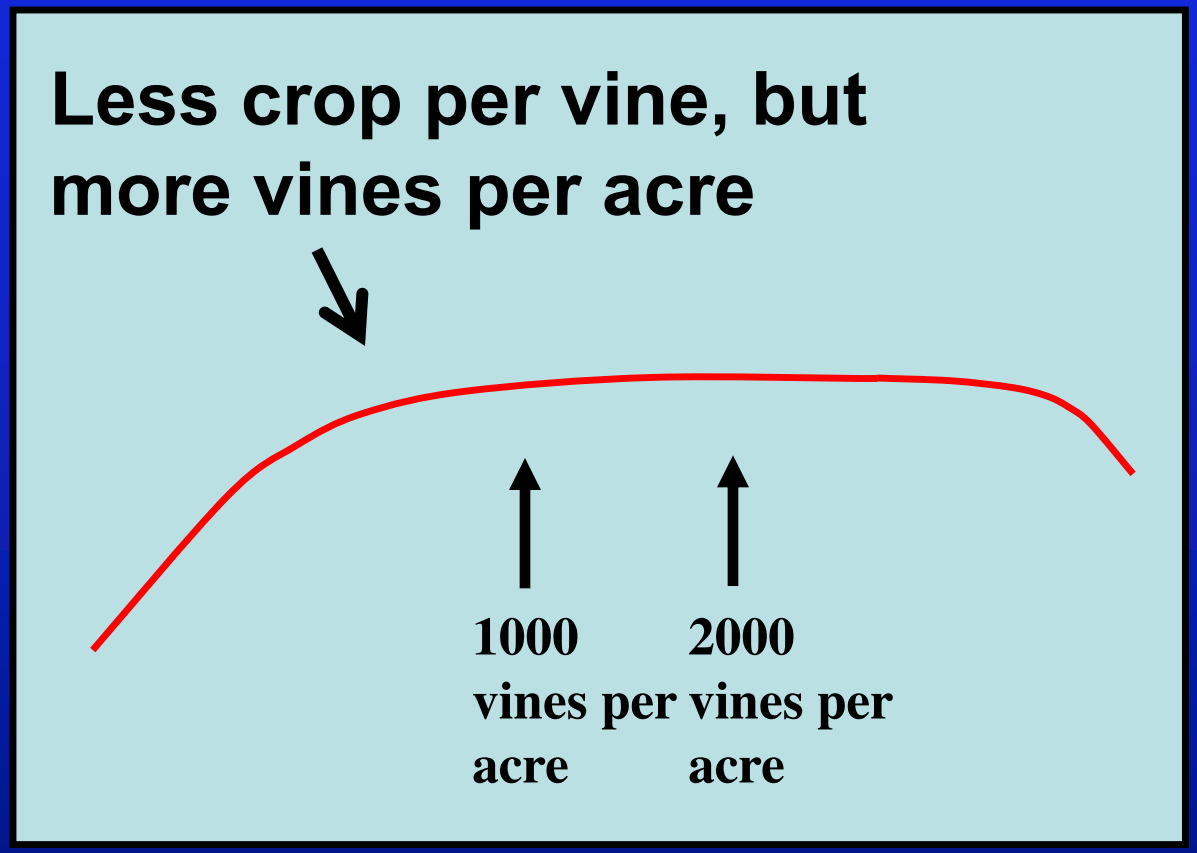

110


9.5

Vine Density Effects



Vine Density Effects

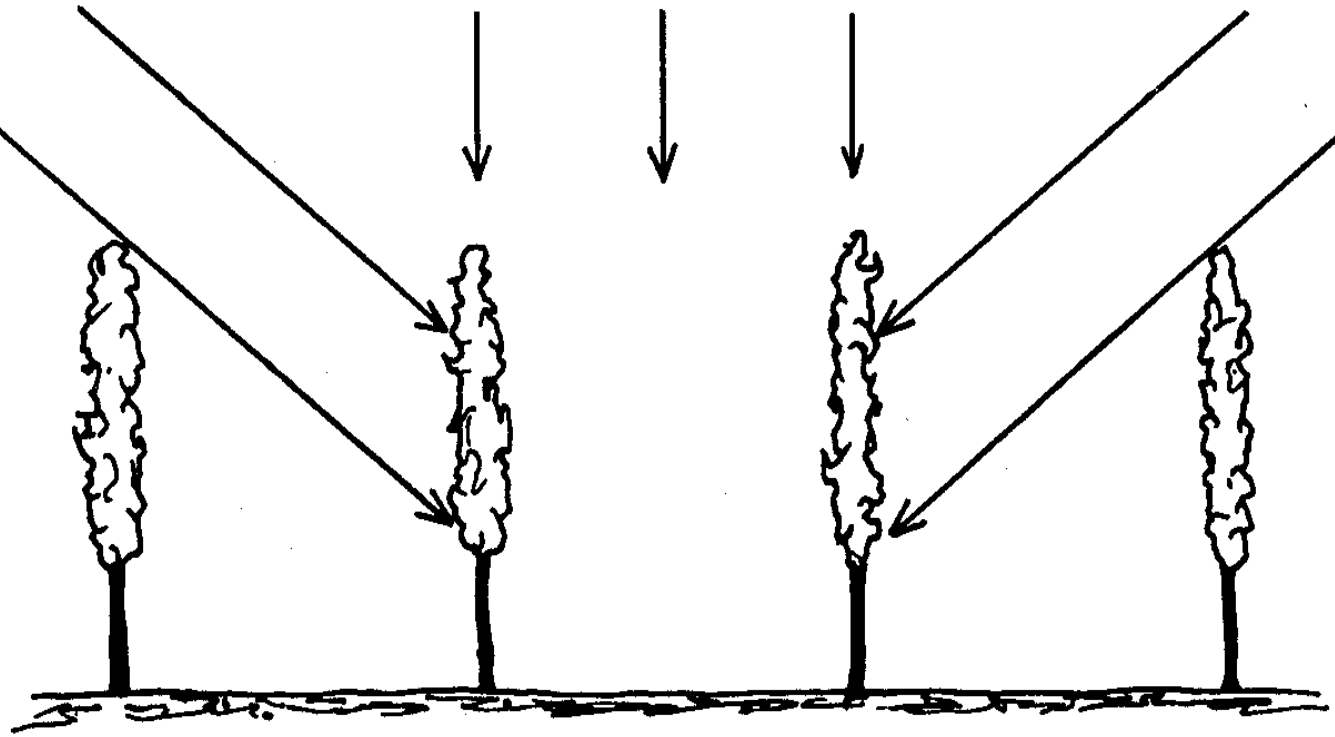



ROW ORIENTATION

Row Direction Considerations

- Row length: long vs. short
- Hillside slope
- Soil variability
- Prevailing wind
- Sunlight interception
- Sunburn
- Ripening uniformity

FIGURE 14: Light interception by a vertically shoot-positioned canopy in the morning, at midday and afternoon.



VSP Trellis

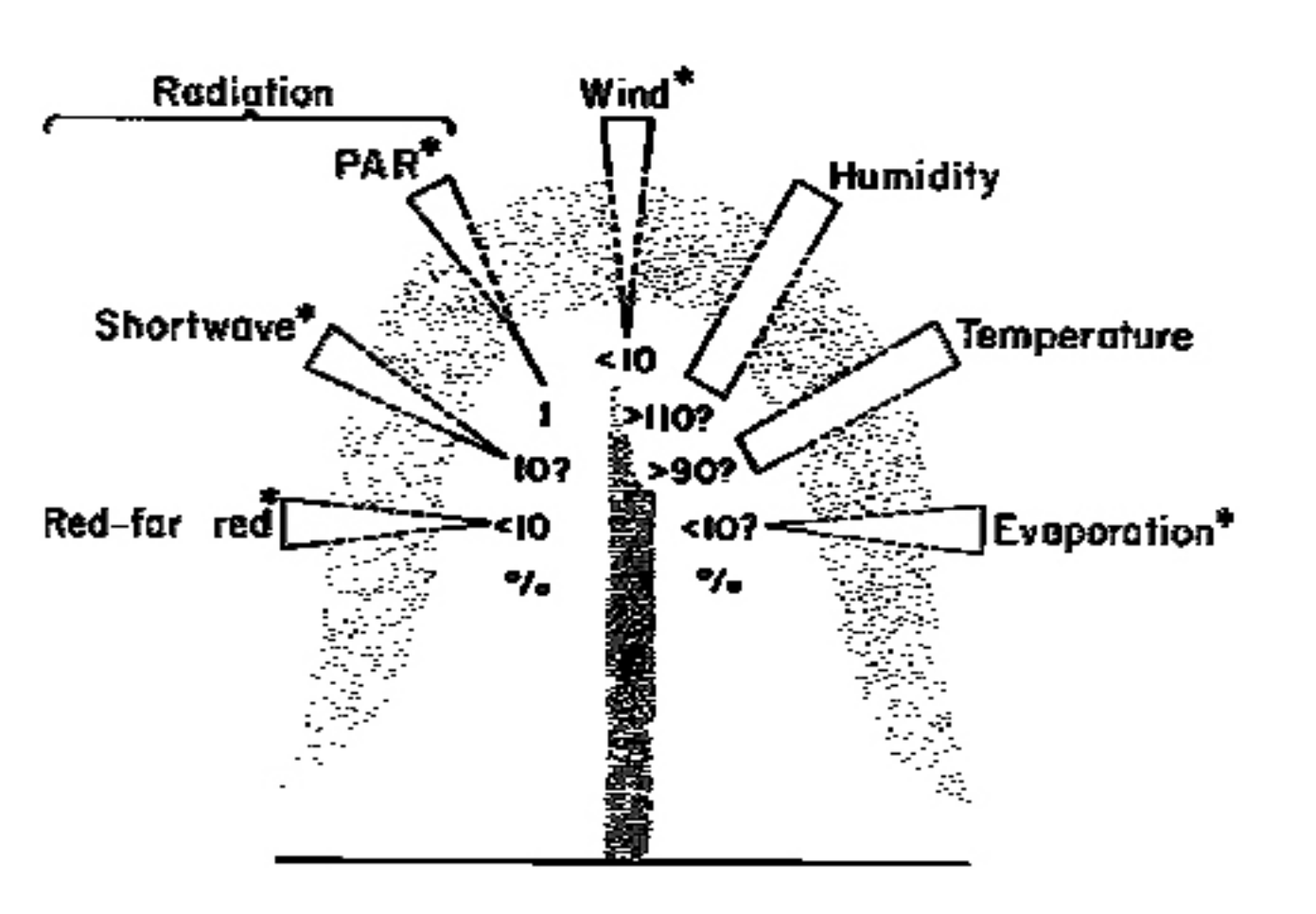
Row Direction	Balance of light exposure (ratio)	Sunburn risk
E-W	Maximum uneven (4:1)	High (south side)
N-S	Even (1:1)	Very high (west side)
NE-SW	Somewhat uneven (2:1)	Moderate (NW)
NW-SE	Somewhat uneven (2:1)	Extremely high (SW side)

TRELLIS

Goals of Training/Trellis System

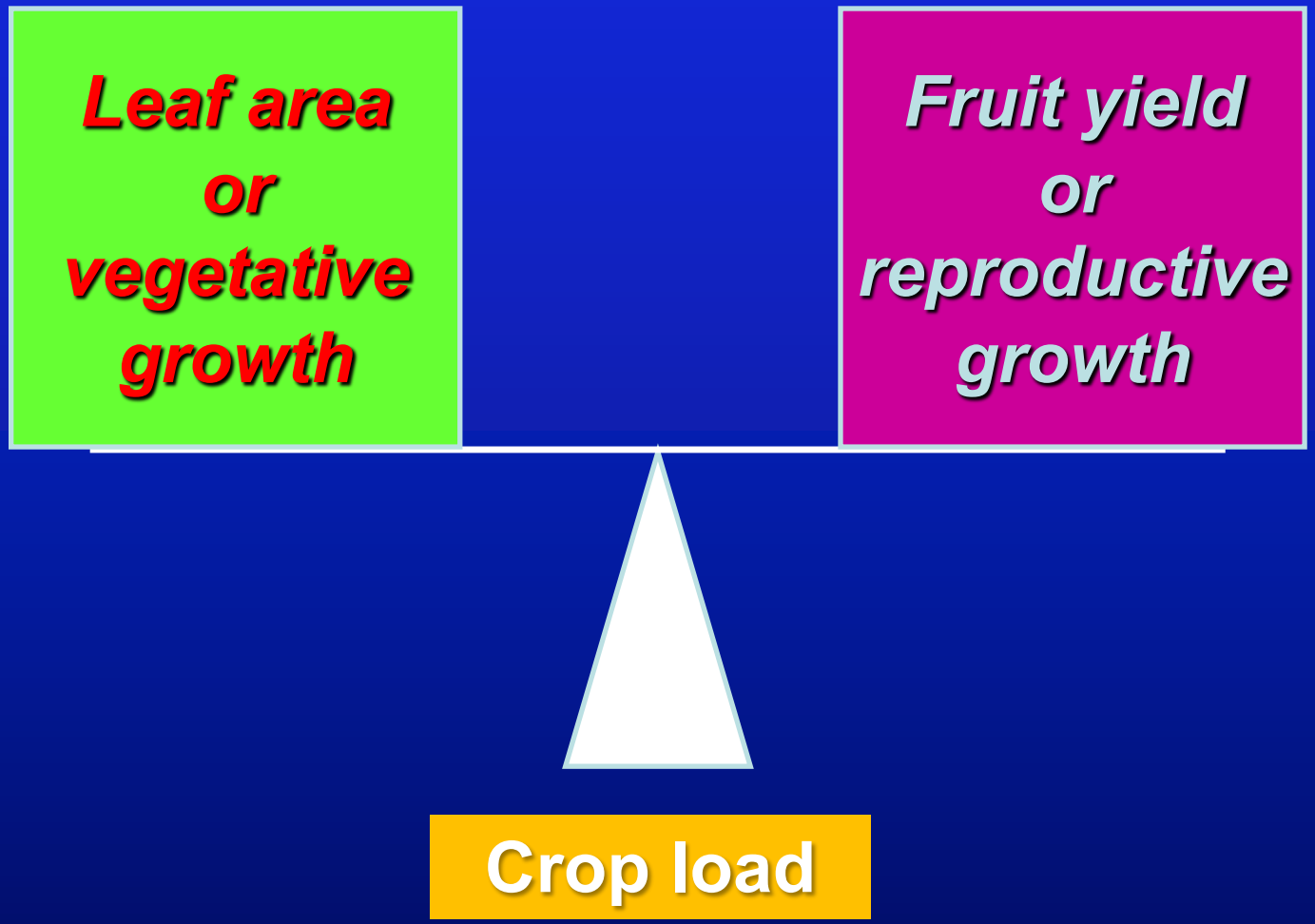
1. Support the mechanical load of the grapevine
2. Facilitate the cultural operations
3. Maximize canopy exposure
4. Improve the canopy microclimate
5. Promote balance between the vegetative growth and crop to optimize quality and quantity

Relative differences in climate in a dense canopy



(Smart 1984)

Vine Balance or Capacity



Canopy Characteristics

Indices	Measure
$\frac{\text{Fruit yield}}{\text{pruning weight}}$	Production efficiency
$\frac{\text{Exposed leaf area}}{\text{Total leaf area}}$	Canopy efficiency -fruit ripening capacity
$\frac{\text{Exposed clusters}}{\text{Total clusters}}$	Fruit exposure -composition and flavor

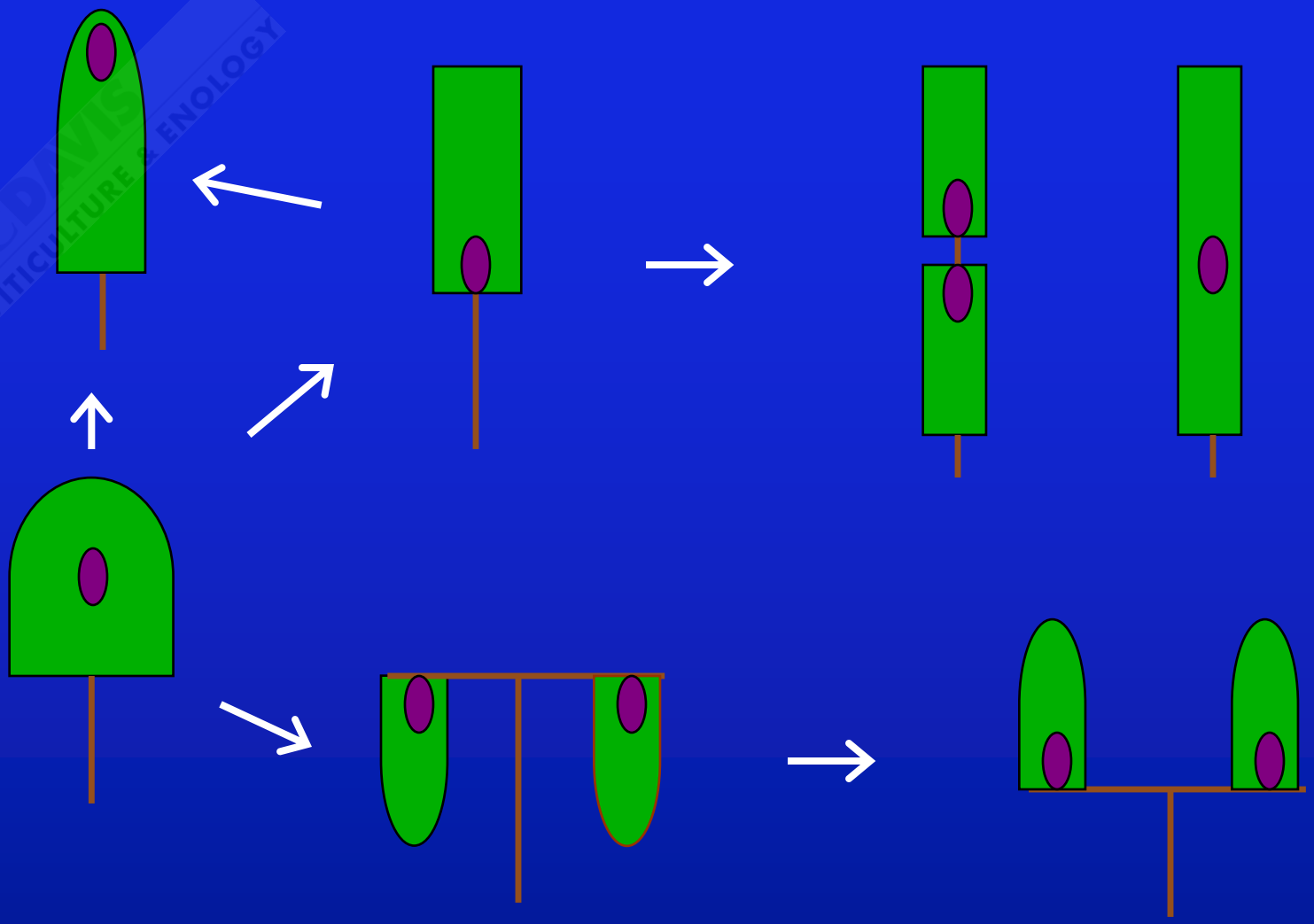
Measuring “balance”

Yield / Pruning Weight ratios

- Lbs of crop / lbs of prunings per vine

<3	Undercropped
4-8	Normal
>10	Overcropped

Reds generally lower than whites



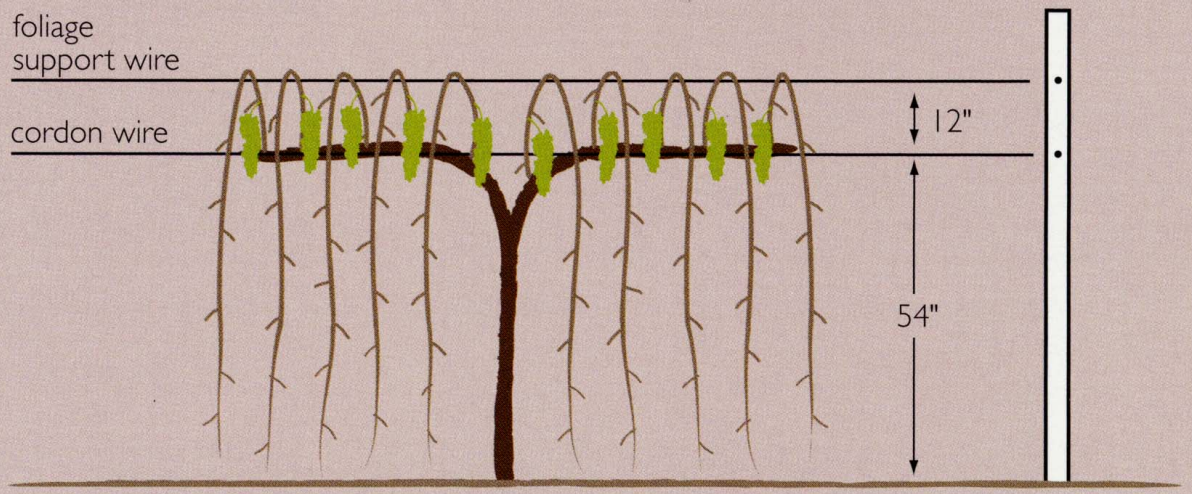
Trellis Options

Non-Trellised

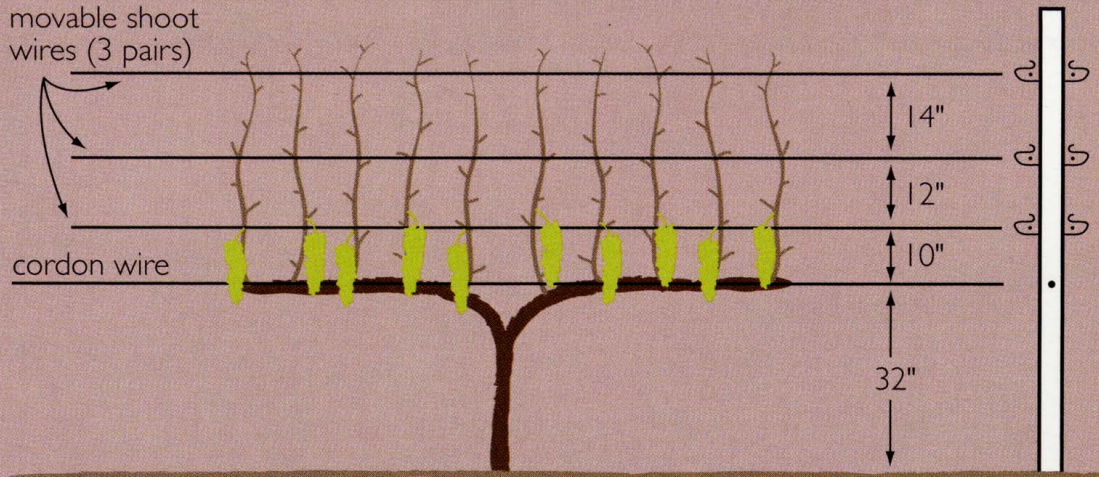
Single Curtain Systems

SINGLE CURTAIN SYSTEMS

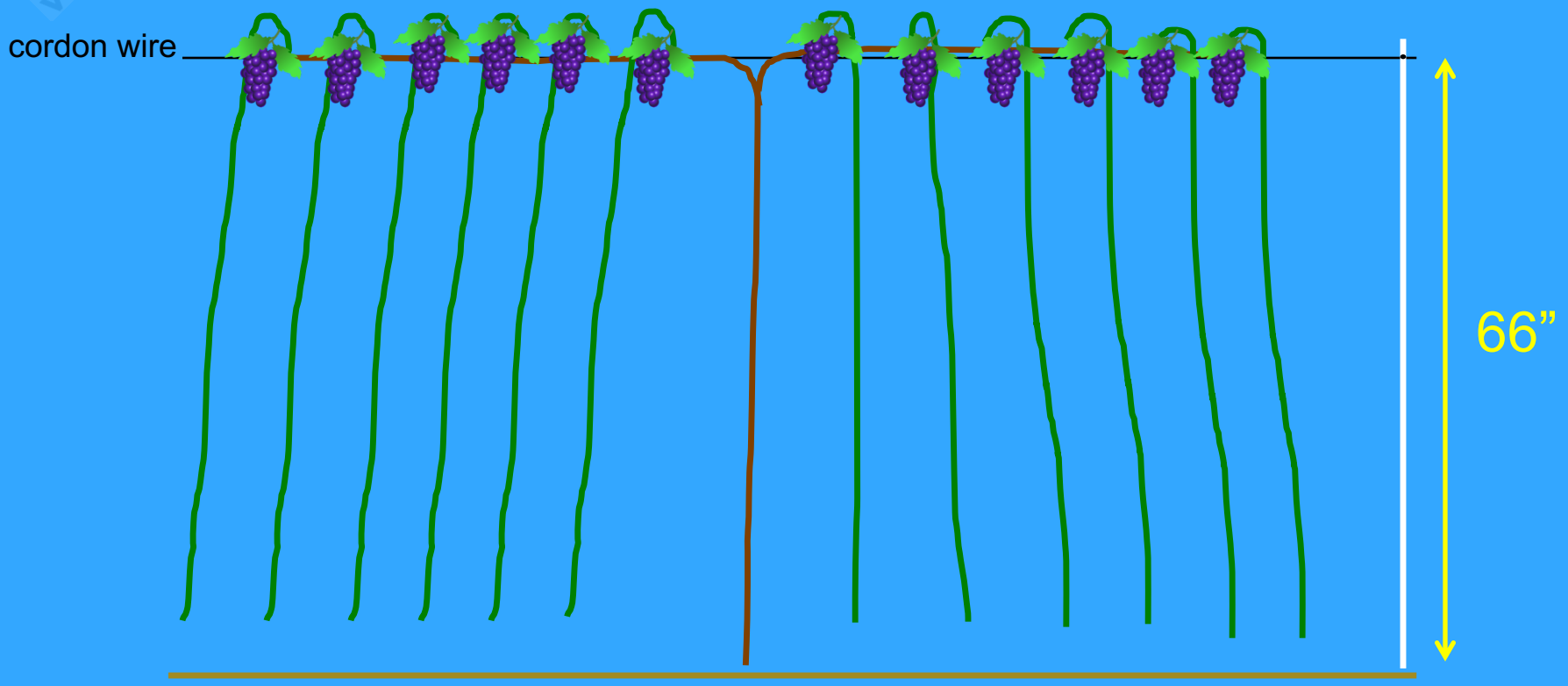
Two-wire vertical trellis (also called Simple Curtain or California Sprawl)



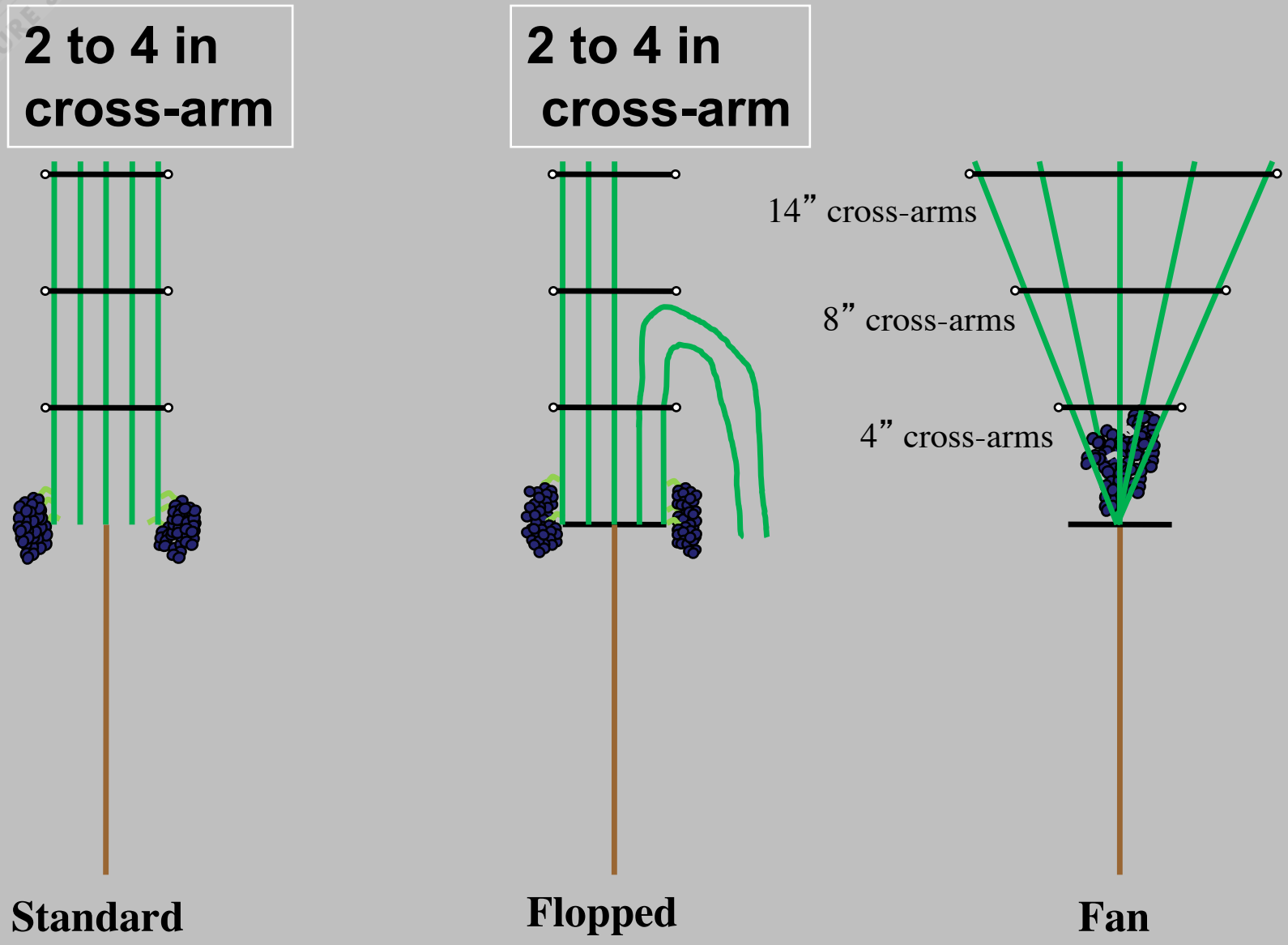
Vertical-shoot-positioned trellis (VSP)



Single wire high cordon



VSP Modifications



Vertical canopy division or separation

Vertically Divided

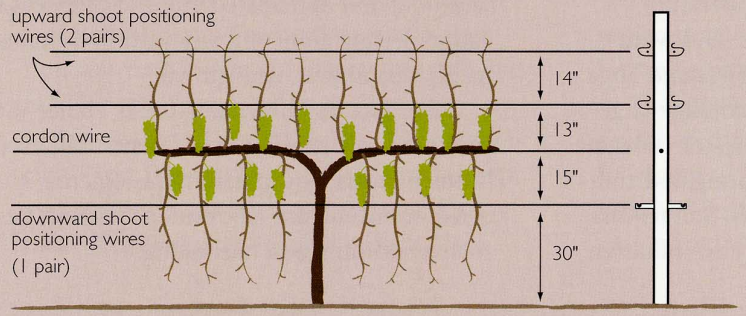
- ✓Scott – Henry
- ✓Smart - Henry

Vertically Separated

- ✓Smart - Dyson

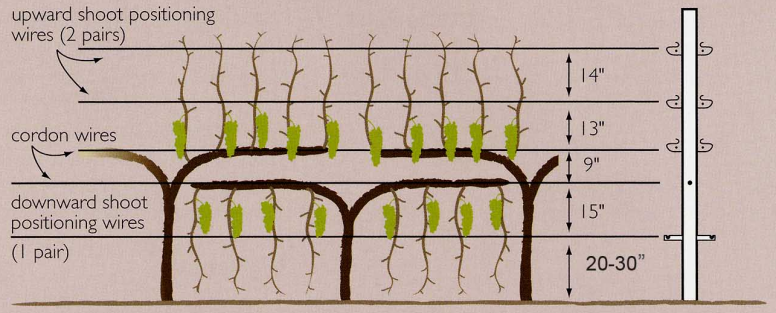
SINGLE CURTAIN SYSTEM WITH VERTICALLY DIVIDED FOLIAGE

Smart-Dyson



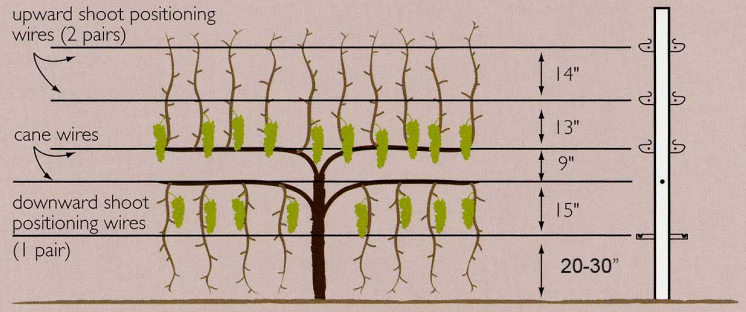
VERTICALLY DIVIDED DOUBLE CURTAIN

Smart-Henry

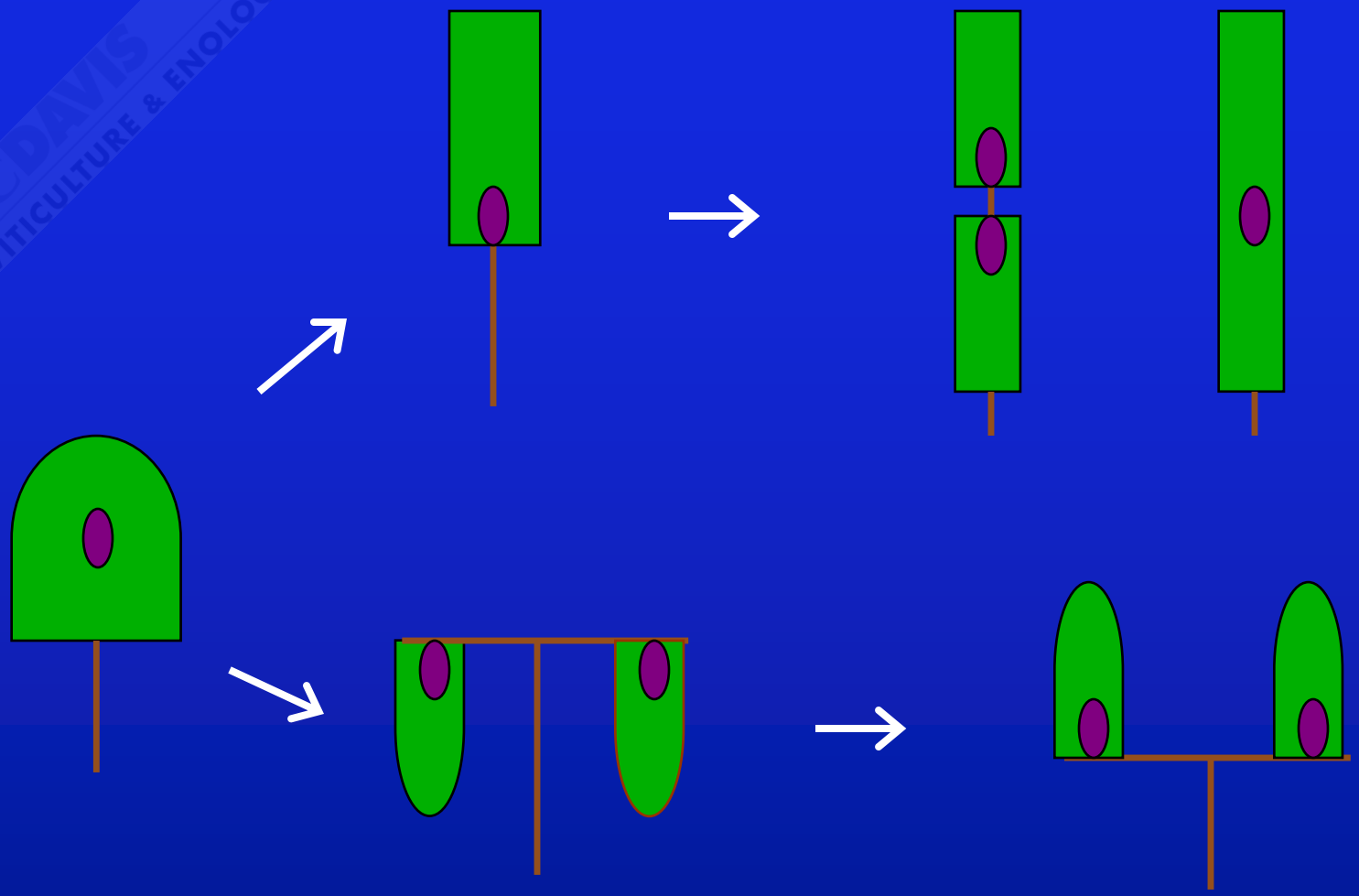


VERTICALLY DIVIDED DOUBLE CURTAIN

Scott Henry



Horizontally Divided Double Curtain Systems

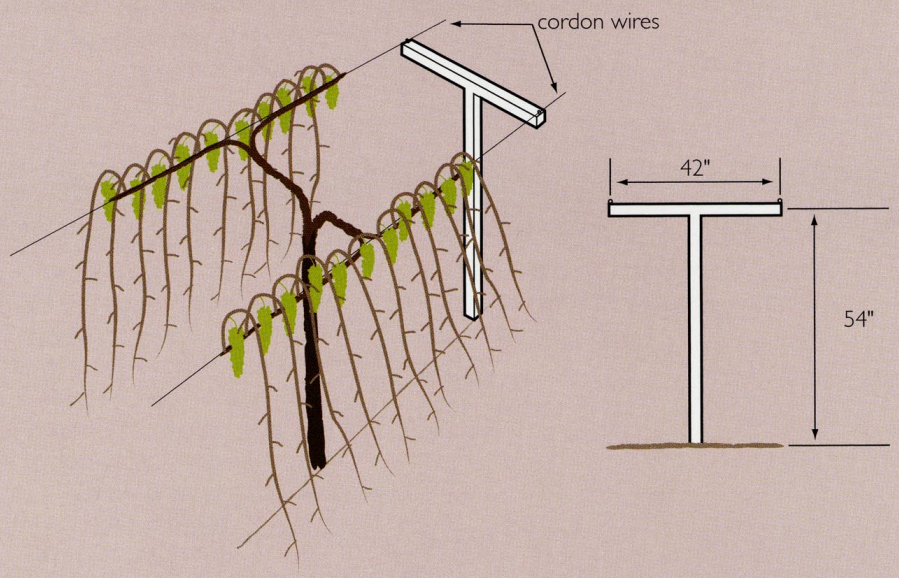


Trellis Options

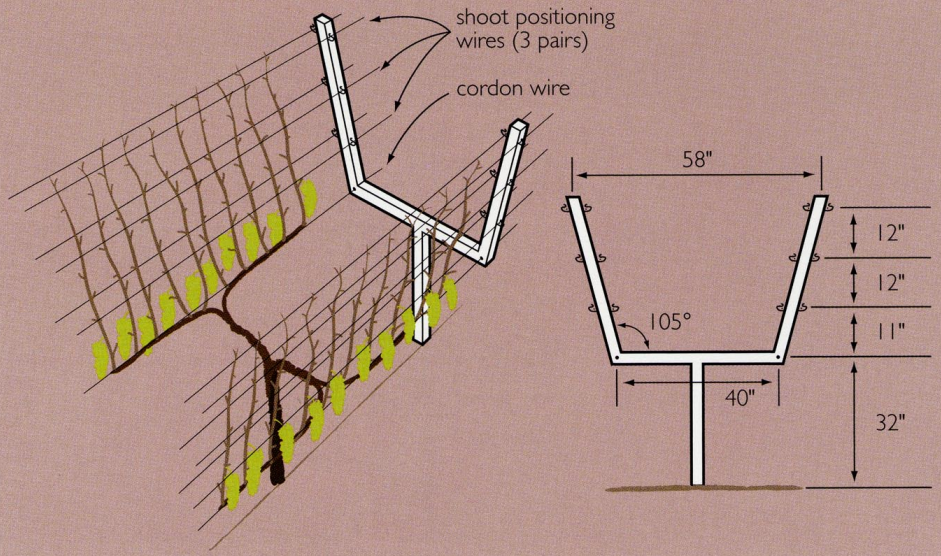
Shoot Orientation	Result
Horizontal/ Downward	Moderate to low growth rate
Vertical	High growth rate

HORIZONTALLY DIVIDED DOUBLE CURTAIN

Double curtain (also called GDC type or Wye trellis)



Lyre trellis



Other Design Considerations

- End assemblies
- Metal or wood trellis materials
- Staging areas
- Turn-around space (20 to 30 ft)
- Ability to mechanize harvest and pruning

Vineyard Design

- ✓ There is not a “one size fits all” design for all sites.
- ✓ For a given site there is no “best” design
- ✓ All factors need to be considered to match the design to the economic and production goals of the vineyard

Summary

- ✓ Vine density and trellis should match vine vigor
- ✓ Ability to predict the potential vigor of a site is key to the decision making process

Questions ?