

## IMPROVING WINE QUALITY BY IRRIGATION AND CANOPY MANAGEMENT

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## WHAT IS CANOPY MANAGEMENT?

**Canopy management** is a portfolio of vineyard operations designed to manipulate fruit and leaf exposure.

It includes vine training and pruning, trellis use, shoot positioning, shoot thinning and leaf and lateral removal

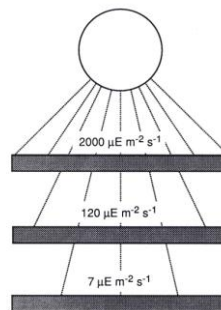


## HOW GRAPEVINES LIKE TO GROW



- ▣ Vines have grown wild for around 60 million years
- ▣ Man has cultivated and selected them for around 8,000 years
- ▣ Vines were in dense forests and needed to climb to the light, hence tendrils, apical dominance etc
- ▣ Grapevines want to produce seedlings
- ▣ Primitive vines had red berries to attract birds
- ▣ Flavors may have a role in dispersal and germination of seedling

## SUNLIGHT ABSORPTION BY LEAVES



- ▣ Leaves strongly absorb light especially in the visible
- ▣ A leaf in bright sunlight transmits only 6 % light
- ▣ Under 2 leaves it is really dark, around 1% of above canopy

## CANOPY MICROCLIMATE CAN EXPLAIN VIGOR AND YIELD EFFECTS ON WINE QUALITY



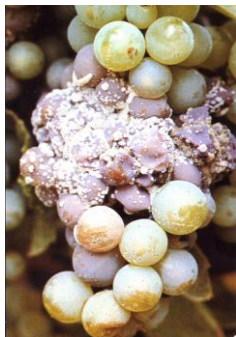
- ▣ Low vigor vines have most of the fruit and leaves well exposed
- ▣ High vigor vines unless well trellised have poor leaf and fruit exposure

## MICROCLIMATE AND YIELD

- ▣ Shade can depress each of the yield components
- ▣ Can be related to vines surviving inside a dense forest
- ▣ Only well exposed, high shoots will produce fruit



## MICROCLIMATE AND DISEASES



- Shaded canopy interiors are more humid, dry more slowly, are difficult for spray to penetrate
- Botrytis bunch rot is worse for interior fruit
- Powdery mildew Oidium is worse for shaded fruit and leaves

## MICROCLIMATE AND WINE QUALITY



- Demonstrated by many studies around the world with several varieties, red and white
- Shade causes:
  - Decreased sugar
  - Decreased anthocyanin and phenols
  - Decreased tartaric acid
  - Decreased flavor compounds, and varietal character
  - Increased juice K and pH
  - Increased malic acid
  - Increased "herbaceous" character
  - Increased Botrytis and premature ageing

## RESULTS IN A HOT AREA Shiraz, Angle Vale, South Australia

Higher yield with GDC			
Higher colour and phenolics with GDC			
Lower pH with GDC			
Higher sensory score with GDC, better flavour			
Shaded canopy described as "hot climate", GDC as "warm climate"			
	<b>Yield t/ha</b>	<b>Shaded Sprawl</b>	<b>Open GDC</b>
		<b>22</b>	<b>27</b>
	<b>Wine pH</b>	<b>3.96</b>	<b>3.49</b>
	<b>Wine color density</b>	<b>2.7</b>	<b>4.3</b>
	<b>Anthocyanin mg/L</b>	<b>280</b>	<b>390</b>
	<b>Phenolics</b>	<b>24</b>	<b>37</b>
	<b>Sensory</b>	<b>11.9</b>	<b>15.4</b>

## RESULTS FROM A COOL AREA Cabernet Franc, New Zealand

The RT2T was balanced, the VSP had too much vigor			
Yield much greater for RT2T due to more sunlight interception			
Less Botrytis with RT2T			
Wine darker, more phenolics, more fruit flavor, strongly preferred for RT2T			
	<b>Yield t/ha</b>	<b>Dense VSP</b>	<b>Open RT2T</b>
		<b>15.8</b>	<b>29.4</b>
	<b>% bunch rot</b>	<b>19</b>	<b>2</b>
	<b>Wine pH</b>	<b>3.40</b>	<b>3.19</b>
	<b>Wine Colour density</b>	<b>2.7</b>	<b>4.3</b>
	<b>Anthocyanins mg/L</b>	<b>160</b>	<b>165</b>
	<b>Wine phenolics</b>	<b>22</b>	<b>24</b>
	<b>Sensory score ex 7</b>	<b>3.5</b>	<b>5.1</b>

## CAUTION, AVOID EXCESSIVE FRUIT EXPOSURE IN HOT CLIMATES

- Afternoon heat corresponds to sun in western part of sky
- Fruit composition is improved by high light but not high temperatures
- Exposed berries can heat to 15 F above air temperature
- Studied in Australia, California and Washington with similar results
- Washington study separated light and temperature effects

## Assessing vigor and trellis system

### Vigor ratings: Assessed by pruning weight

**Low**, less than 0.45 lb pruning weight /ft (0.6 kg/m), use VSP, "sprawl"

**Medium**, 0.45 to 0.75 lb/ft (to 1.0 kg/m), use Scott Henry, Smart Dyson, Lyre

**High**, more than 0.75 lb/ft (1.0 kg/m), use GDC



## VINE BALANCE



### A balanced vine has:

Yield: pruning ratio (Ravaz index) of around 5:1

Mean cane weight of about 45 g (0.1 lb)

Vine is pruned to about 30 buds per kg pruning weight

## AN IDEAL CANOPY...

- ▣ Growth is balanced
- ▣ Intercepts much sunlight
- ▣ Shoots spaced each 2.5 in, or 4.5 shoots per foot
- ▣ About 40 % canopy gaps, 60 % fruit exposure
- ▣ Shoots should be 15 nodes long, about 42"
- ▣ Avoid fruit exposure to mid afternoon sun ie to west



## SPRAWL

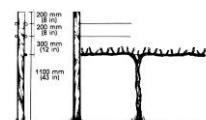


- ▣ Suitable only for low vigour, low yield vineyards
- ▣ Requires 1 fruit wire, 1? foliage wire
- ▣ Can produce excellent canopy microclimate when vines are low vigour, shoots are about 30 in and naturally terminating, remain erect
- ▣ Can produce excellent wine
- ▣ Can be head/goblet pruned
- ▣ Relatively low cost and labor input
- ▣ Can mechanize harvest, winter pruning

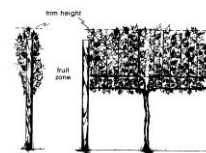
## VERTICAL SHOOT POSITIONING VSP

- ▣ Suited to low to moderate vigour, Requires 1 fruit, 4 foliage wires, 6 ft post ex ground
- ▣ Need 28 in minimum post height above cordon
- ▣ Suited to cordon training and spur pruning
- ▣ Easy to mechanize Winter Prune (WP), Summer Prune (SP), Harvest (H), Leaf Removal (LR)

## VERTICAL SHOOT POSITIONING



nd and side view for VSP media showing spur pruning.

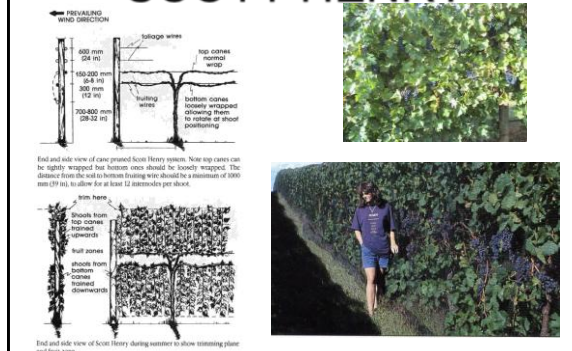


## SCOTT HENRY

- ▣ Suited to moderate vigour
- ▣ Suited to cane pruning and so cooler climates
- ▣ Requires 5 foliage wires, 2 fruiting wires, 6 ft post
- ▣ Mechanize summer prune, leaf removal, harvest
- ▣ Will produce typically 30% higher yield than VSP, with improved quality



## SCOTT HENRY



## SMART DYSON

- Suited to moderate vigour, say 0.45 to 0.75 lb pruning weight per foot row
- Is suited to spur pruning and so warm to hot climates
- Shoot position bottom curtain towards west
- Requires 5 foliage wires, 2 fruiting wires, 6 ft post
- Mechanize winter prune, summer prune, leaf removal, harvest
- Will produce typically 30% higher yield than VSP, with improved quality
- Is equivalent to Scott Henry system, but with no gap between shoot zones

## SMART DYSON



## SMART DYSON BALLERINA

- A modification of the Smart Dyson used for retrofitting cordon trained VSP vines with upwards pointing spurs.
- Train say half shoots upwards, remainder to one or both sides
- Gradually will form spurs pointing to sides or down



## IRRIGATION

THE IMPORTANCE OF SOIL  
WATER MANAGEMENT IN  
QUALITY WINE PRODUCTION

## WHY IRRIGATE VINEYARDS?

- To manage water stress
- To maximise growth, especially for young vines
- to optimise yield and quality for mature vines
- to reduce production irregularity
- Irrigation is your most powerful tool. Use it wisely!!

### WATER STRESS AND MATURE VINES, EFFECTS ON YIELD

	No stress	Timely and moderate stress	Severe stress
Berry size	Large	Smaller	Very small
Berry number	Large?	Large?	Small

### WATER STRESS AND MATURE VINES, EFFECTS ON GROWTH

	No stress	Timely and moderate stress	Severe stress
Shoot length	Long	Moderate	Small
Leaf area	Large	Moderate	Small
Lateral number	Many	Few	None

### WATER STRESS AND MATURE VINES, EFFECTS ON QUALITY

	No stress	Timely and moderate stress	Severe stress
Red wine	Poor	High	Reduced?
White wine	OK?	High?	Poor

### WATER STRESS AND YOUNG VINES, EFFECTS ON GROWTH

	No stress	Timely and moderate stress	Severe stress
Root, shoot and leaf growth	Maximum	Some reduction	Poor

### HOW TO IRRIGATE? BY DRIP!!

- Now 40 year old technology
- Cheap and reliable
- Water use effective
- Can incorporate nutrients "fertigate"
- Limited wetted zone for weed control
- Designed for frequent applications of small amounts of water

### HOW TO IRRIGATE? BY DRIP!!

- Does not wet foliage – less disease
- Can match application rate to infiltration
- Easy to automate and monitor
- Relatively low maintenance

## HOW TO IRRIGATE? BY DRIP!!

### Disadvantages

- Does not wet all soil surface so difficult to sow cover crops
- Less effective at frost control
- Vine root zone can be too restricted

## IRRIGATION DECISIONS

- How much to irrigate?
- When to irrigate?

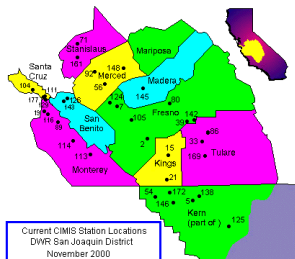
## IMPORTANCE OF SOIL

- Soil (root) depth and water holding capacity all important
- clay and silt hold more water than loam and sand
- Deep soils can store a lot of winter rainfall

## ESTIMATING WATER NEED

- For any vineyard need to know monthly rainfall and evapotranspiration

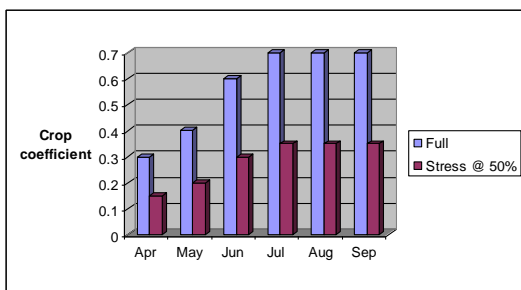
## CIMIS NETWORK in CA



## MEASURING ETo



## Values of crop coefficient $k_c$



## MONITORING IRRIGATION

- Soil measurement
  - gypsum blocks, capacitance C probes etc
- Plant measurement
  - pressure bomb, dendrometer
- Plant observation
  - leaf colour, wilting, shoot tips etc

## TDR



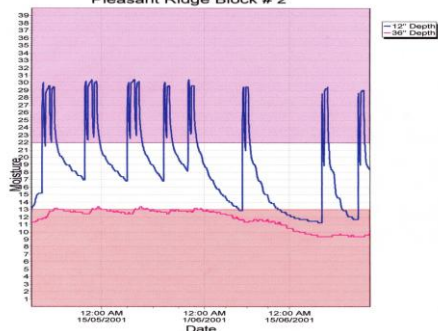
## CAPACITANCE METERS



C probe  
Enviroscan

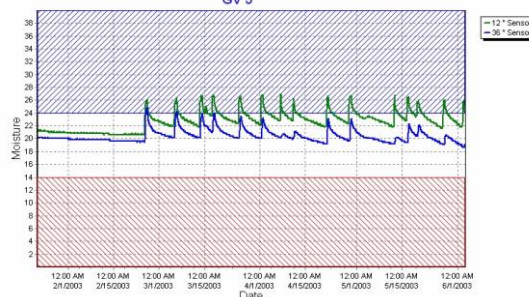
## SHALLOW FREQUENT IRRIGATIONS WHILE SUB SOIL DRIES

Pleasant Ridge Block # 2



## OVER IRRIGATION EARLY IN THE SEASON?

GV 5





## PLANT MEASUREMENT

Dendrometer



Pressure bomb



## PLANT APPEARANCE



Tendrils erect, tip growing



Tendrils droop, no tip growth

## PLANT APPEARANCE



Leaf backs show

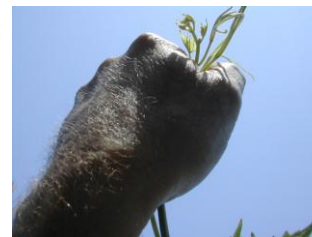


Leaves necrotic, fall off

## Smart shoot growth index

Pull the shoot tip through the cupped hand. Observe the last leaf or tip to pass through the hand.

- ▣ Growing, leaf tip is last through hand
- ▣ Slowing growth, leaf tip is even with leaf below tip
- ▣ Growth slowed, leaf below tip is last through hand



## IRRIGATION MANAGEMENT

- ▣ No stress early in season
- ▣ Stop shoot growth about two weeks before envero (veraison)
- ▣ Maintain moderate but not excessive water stress to harvest

## ASSESS LEAF TEMPERATURE- The smart leaf temperature index

- ▣ Do measurements about 2-3 pm
- ▣ Choose leaves well exposed to sun
- ▣ Touch quickly





## SCORE CARDS

- Use 5 point score card up until veraison based on shoot growth
- Use different 5 point scorecard after veraison based on whole vine appearance to avoid too much stress

SCORE	STAGE	DESCRIPTION
1	Actively growing	Tip is beyond all leaves, 3 tendrils can reach past tip, last tendrils more or less in line with shoot tip.
2	Slowing	Tip is beside edge of youngest leaf, 2-3 tendrils can reach past tip
3	Stopped	3 rd separated leaf only will reach past tip, 2-3 tendrils may reach past tip
4	Stopped with some stress	Tip has stopped elongating, can be covered by 4 or more leaves, tendrils small
5	Stopped, with severe stress	Tip becomes dessicated and dehisces, tendrils near tip generally the same

SCORE	STAGE	TIPS	TENDRILS NEAR TIP	BASAL LEAF COLOUR	MID LEAF CONDITION	MID LEAF TEMP. (only if sunny)
1	No stress	Actively growing	Turgid, point more or less to tip	Dark green, shiny	Leaves turgid, somewhat crisp, point to canopy outer, sloping	Some leaves slightly warm
2	Early stress	Slowing	First sign drooping	Dark green, more dull	Leaves point to canopy outer, few vertical, most sloping	Many leaves slightly warm
3	Minor stress	Stopped	Tendrils short, wilting.	Paler green but with yellow or grey tones	Leaves begin to align vertically, backs become evident	Some leaves hot
4	Moderate stress	Dehisced	Dehisced	Leaves look yellow-green, or pale green, few yellow leaves at base	Leaves cupping, wilted, show backs in wind	Some leaves hot
5	Severely stressed	Dehisced	Dehisced	More yellow leaves to mid shoot, some basal defoliation	Leaves cupped, vertical, many backs evident	Some leaves hot

## SUMMARY

- Timely stress is important
- Stop shoot growth before veraison
- Can estimate irrigation requirements
- Measure soil and plant to monitor irrigation and stress
- Dry out subsoil before irrigating