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VITICULTURE CONSORTIUM PROGRAM

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Project Title: Alternative Trellising Systems for Chardonnay and Merlot Vineyards in the Central Coast

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ABSTRACT

The purpose of this study is to compare the performance of bilateral cordon trained, spur pruned Chardonnay and Merlot grapevines trellised to the vertically shoot positioned trellis system (VSP), the Smart-Henry trellis system (SH) and the Smart-Dyson trellis system (SD) in the Salinas Valley of California. Primary leaf size, as well as primary, lateral and total leaf area per vine, did not differ significantly among the treatments. VSP vines had greater leaf layer numbers in the fruiting zone compared to SD and SH vines, and these treatments had greater amounts of sunlight in the fruit zone compared to the VSP treatment. Vine yield components were similar among the treatments in both cultivars. Compared to upward-oriented canopies, trends toward reduced yields for downward-oriented canopies were observed in Chardonnay, while the opposite was true for Merlot. Pruning weights and pruning weight ratios were similar among the treatments in both cultivars. Fruit on downward-oriented shoots on the SH and SD systems generally ripened more slowly compared to shoots oriented upward. At harvest, however, no significant differences in combined fruit (upper and lower canopies) soluble solids, titratable acidity and pH were observed among the treatments in either cultivar. Wine lots made from each treatment will be evaluated in 2000.

OBJECTIVES

The purpose of this study is to compare the performance of bilateral cordon trained, spur pruned Chardonnay and Merlot grapevines trellised to the vertically shoot positioned trellis system (VSP), the Smart-Henry trellis system (SH) and the Smart-Dyson trellis system (SD). The specific project objectives are as follows:

1. Evaluate canopy light and growth parameters: determine light interception and penetration for each trellis system; measure leaf area density and canopy surface area in each system; evaluate canopy density parameters and determine cluster and leaf exposure for each trellis type. Characterize differences between upward and downward positioned canopies with the same trellis type (SD and SH systems).

2. Measure effects on vine growth, productivity and fruit quality: determine the influence of trellis type on vine yield components, fruit composition, disease incidence, vegetative growth and wine quality. Characterize differences in yield components, vegetative growth and fruit ripening of upward and downward positioned canopies with the same trellis type (SD and SH systems).

PROCEDURES

Vineyard Site

The experimental vineyard is located near Greenfield in the Salinas Valley, and was selected on the basis of its uniform growth, moderate vine vigor, and cultivar availability. Chardonnay and Merlot were planted in 1994 on 3309 rootstock, spaced 8' (between rows) x 6' (between vines) and oriented in a north-south row direction. The cultivars are planted in two adjacent vineyard blocks. The vines are bilateral cordon trained and spur pruned. Spur pruning is employed in the trial in order to facilitate mechanical pre-pruning. The vines are drip irrigated, and standard cultural practices for the cultivar and region are followed. Shoot positioning and hedging are employed as indicated in each system.

Treatments and Experimental Design

Each trellis treatment was replicated eight times using 12 vine plots in each cultivar. The middle four vines in each plot were used for light, canopy assessment, and vine performance measurements (i.e., non-destructive measurements). Additional vines in each plot are utilized for destructive canopy measurements as needed. Pruning is performed using standard commercial practices, based on the capacity and canopy surface of each system. All systems were pruned to 20, 2-bud spurs per vine. On the SD system, care was taken to orient an equal number of spurs downward and upward. SH vines were pruned to 20 spurs per vine, resulting in double the number of spurs per unit row length compared to the other treatments.

Light Microclimate

Light measurements were taken at regular intervals (berry set, veraison and harvest) during the growing season to calculate both sunlight interception and penetration for each system.

Measurements were performed on clear days and completed within one hour $\pm$ solar noon, or 1300 hours, Pacific Daylight Time (PDT). The light environment along a vertical transect of the canopy was determined in the center of the vine row in each plot. A vertically positioned fiberglass rod (20 mm diameter), 2 m in length and marked at 0.20 m increments, was used as a guide. Four transect locations were established in each plot. Measurements from the four locations were combined, with respect to distance above ground, and used to calculate mean values. Fruit zone measurements were taken by positioning a 1.2 m, 12 mm diameter fiberglass rod horizontally in either the east or west half of the vine space, immediately above the apical clusters of the fruit zone. Measurements were collected at 0.1 m increments beginning at the vine trunk in four locations in each plot. Readings from the four locations were combined with respect to transect position to determine fruit zone light environment. Photosynthetic Photon Flux (PPF) was measured using a LI-COR LI-190S quantum sensor attached to a LI-COR LI-185 quantum meter (LI-COR, Inc., Lincoln, Nebraska). The percent canopy area receiving sunflecks was determined using a sunfleck ceptometer (Decagon Devices, Inc., Pullman, Washington). Upward and downward positioned canopies in the SH and SD systems were measured separately.

Leaf Area and Pruning Weight Determinations

A randomly selected buffer vine in each replicate was defoliated near harvest to determine leaf area. Primary shoot length was recorded, and primary and lateral leaf areas separated. In the case of the SH and SD treatments, leaves from upward and downward positioned shoots were separated. A LI-COR area meter was used for leaf area determinations. The leaf area:canopy area ratio was calculated by dividing vine leaf area by canopy ground area. Pruning weights and individual shoot weights were collected at dormancy. The pruning and shoot weights of upward and downward positioned shoots in the SH and SD systems were measured separately.

Canopy Assessment Indices

Point quadrant measurements were performed two to three weeks prior to harvest using the method of Smart (Smart, 1985). The sharpened tip of a 1.2 m rod (3 mm diameter) was positioned perpendicularly to the canopy surface at the height of the fruit zone. The rod was inserted into the canopy interior at an angle of 90^o with respect to the canopy exterior, and the number of leaves intercepted by the tip of the rod recorded. One hundred insertions (50 insertions made at 5 cm intervals on both the north and south side of the vine row) were performed in each replicate. Canopy gaps were expressed as the percentage of insertions in which no leaf contacts were made. Upward and downward positioned portions of the SH and SD systems were analyzed separately.

Vine Performance Evaluations

Vine yield components (shoots/vine, clusters/shoot, berries/cluster, berry weight and total fresh weight, bunch rot incidence) were calculated for each treatment. Berry samples were collected at regular intervals to monitor fruit ripening and composition (sugar, acid, pH). Yield components and fruit composition from upward and downward positioned shoots in the SH and SD systems were recorded separately.

Wine Quality

Fruit ripening was monitored and treatments harvested at similar soluble solids levels (23 to 24 ^{o}Brix) from wine making purposes. Approximately 30 pounds of fruit was collected from each replicate and combined into a single fruit lot in each treatment. Wines were made and analyzed at the University of California, Davis experimental winery.

RESULTS

Canopy Size and Density Characteristics

Primary, lateral and total leaf area per vine did not differ significantly among the treatments. Point quadrant analysis revealed that SD and SH trellising systems reduced canopy density compared to the VSP system in both cultivars. VSP vines of both Chardonnay and Merlot had greater leaf layer numbers in the fruiting zone compared to SD and SH vines (Table 3). Canopy gaps were low for all systems in both cultivars. VSP vines generally had fewer exposed leaves and clusters than the remaining treatments.

Light Attenuation Characteristics within the Canopy

Sunlight within the canopy interior decreased significantly with canopy depth in all systems, however, SD and SH vines had greater amounts of sunlight in the fruit zone compared to VSP vines. This reflected the reduced leaf area density of these treatments.

Yield Components

Vine yield components did not differ among the treatments in either cultivar. A trend toward reduced yields for downward-oriented canopies, compared to upward-oriented canopies, was observed for Chardonnay. In contrast, downward-oriented canopies of Merlot had lower yields compared to upward-oriented canopies.

Pruning Weight and Production Efficiency

No significant difference in pruning weight per vine or the yield:pruning ratio was observed among the treatments in Merlot. Chardonnay vines grown on the VSP had significantly greater pruning weights compared to the remaining treatments.

Fruit Ripening and Composition

Fruit from downward-oriented shoots generally exhibited reduced rates of sugar accumulation and higher titratable acidity compared to fruit from upward-oriented shoots. Fruit on downward-oriented shoots on the SH system exhibited this trend more severely than downward-oriented shoots on the SD system. No significant difference in soluble solids, titratable acidity or juice pH were observed among the treatments in either cultivar. Wine lots made from each treatment will be evaluation in 2000.

OUTSIDE PRESENTATIONS

The results of this study were presented at Central Coast Wine Grape Day (March 1999) and the UC Canopy Management Short Course (August 1999). Written summaries of the work were included the proceedings of both meetings.

SUCCESS STATEMENTS

Vertically divided (Smart Henry) and vertically separated (Smart Dyson) trellis systems are increasing in popularity in many wine growing regions of the state. The results of this work are being used by both growers and vintners to determine if these systems provide significant advantages compared to the VSP system. Thus far, we have shown that both the Smart Dyson and Smart Henry systems decrease canopy density and increase potential production capacity compared to the VSP. However, we have also confirmed grower observations that fruit ripening rate often differs between the upper and lower tiers of the canopy. These differences are more severe on the Smart Henry compared to the Smart Dyson system, and appear to be heavily dependent upon crop load. We found few differences in vine yield components among the treatments in 1999, and fruit composition did not differ significantly among the trellises in either cultivar. Wine lots made from each treatment will be evaluated in 2000.

STATUS OF FUNDING

Approximately $2,000 remains in this project account. These funds will be used to perform wine sensory analyses for the 1999 vintage.

Table 1. Influence of training/trellis system on the Canopy configuration of Chardonnay and Merlot grapevines.

Trellis	Cordons per m row length	Canopy orientation	Canopy volume (m^3)
VSP	1	Up	1.3
Smart-Dyson	1	Up	1.2
		Down	0.8
		Total	2.0
Smart-Henry	2	Up	1.1
		Down	0.7
		Total	1.8

Table 2. Influence of training/trellis system on the primary, lateral and total leaf area of Chardonnay and Merlot grapevines. 1999.

Cultivar	Trellis	Canopy orientation	Leaf area/vine (m^2) Primary	Lateral	Total	Primary leaf size (cm^2)
Chardonnay	VSP	Up	4.4 a[z]	1.6 a	6.0 a	63 a
	Smart-Dyson	Up	2.1	0.8	2.9	52
		Down	1.7	1.0	2.7	64
		Total	3.8 a	1.8 a	5.6 a	57 a
	Smart-Henry	Up	2.9	0.7	3.6	59
		Down	2.2	0.9	3.1	62
		Total	5.1 a	1.6 a	6.7 a	61 a
Merlot	VSP	Up	5.8 a	1.7 a	7.5 a	75 a
	Smart-Dyson	Up	3.0	1.1	4.1	59
		Down	2.8	1.4	4.2	68
		Total	5.8 a	2.5 a	8.3 a	63 a
	Smart-Henry	Up	1.7	1.0	2.7	54
		Down	2.4	1.6	4.0	71
		Total	4.1 a	2.6 a	6.7 a	62 a

[z] Numbers followed by the same letter within columns and for each cultivar are not significantly different at the 5% level (DMRT)

Table 3. Influence of training/trellis system on some canopy characteristics of Chardonnay and Merlot grapevines. 1999.

Cultivar	Trellis	Canopy orientation	Leaf layer number	Canopy gaps (%)	Exterior leaves (%)	Exterior clusters (%)
Chardonnay	VSP	Up	3.7 a[z]	2 a	62 a	19 b
	Smart-Dyson	Up	2.8 b	2 a	32 b	28 a
		Down	2.1 c	7 a	38 b	27 a
	Smart-Henry	Up	2.8 b	2 a	24 b	9 b
		Down	2.0 c	2 a	28 b	31 a
Merlot	VSP	Up	3.0 a	3 a	61 a	17 bc
	Smart-Dyson	Up	2.5 ab	6 a	37 b	26 a
		Down	2.3 b	8 a	40 b	22 ab
	Smart-Henry	Up	2.6 ab	7 a	32 b	12 c
		Down	2.3 b	8 a	41 b	29 a

[z] Numbers followed by the same letter within columns and for each cultivar are not significantly different at the 5% level (DMRT)

Table 4. Influence of training/trellis system on the yield components of Chardonnay and Merlot grapevines. 1999.

Cultivar	Trellis	Canopy orientation	Yield per vine space (lbs/6 ft)	Tons per acre	Clusters per vine space (6 ft)	Cluster weigh (g)	Berries per cluster
Chardonnay	VSP	Up	14.8 a	6.7 a	61 a	110 a	87 a
	Smart-Dyson	Up	7.5		31	109	87
		Down	6.6		32	94	73
		Total	14.1 a	6.4 a	65 a	98 a	77 a
	Smart-Henry	Up	8.4		33	115	90
		Down	5.3		29	81	69
		Total	13.7 a	6.2 a	62 a	99 a	81 a
Merlot	VSP	Up	6.6 a	3.0 a	59 a	52 a	40 a
	Smart-Dyson	Up	3.5		28	55	42
		Down	5.3		34	70	54
		Total	8.8 a	4.0 a	61 a	64 a	49 a
	Smart Henry	Up	4.2		35	53	40
		Down	5.3		31	79	61
		Total	9.3 a	4.2 a	66 a	64 a	49 a

[z] Numbers followed by the same letter within columns and for each cultivar are not significantly different at the 5% level (DMRT).

Table 5. Influence of training/trellis system on the pruning weight and yield:pruning weight ratio of Chardonnay and Merlot grapevines. 1999.

Cultivar	Trellis	Canopy orientation	Pruning wt. (lbs/vine)	Yield Pruning wt.
Chardonnay	VSP	Up	1.5 b	9.9 a
	Smart-Dyson	Up	0.8	9.4
		Down	1.0	6.6
		Total	1.8 a	7.8 b
	Smart-Henry	Up	0.9	9.3
		Down	0.8	6.6
		Total	1.7 ab	8.1 b
Merlot	VSP	Up	1.7 a	3.9 a
	Smart-Dyson	Up	0.7	5.0
		Down	1.0	5.3
		Total	1.7 a	5.2 a
	Smart-Henry	Up	0.9	4.7
		Down	0.8	6.6
		Total	1.7 a	5.5 a

[z] Numbers followed by the same letter within columns and for each cultivar are not significantly different at the 5% level (DMRT).

Table 6. Influence of training/trellis system on the fruit composition of Chardonnay and Merlot grapevines at harvest. 1999.

Cultivar	Trellis	Canopy orientation	Soluble solids (°Brix)	Titratable acidity (g/L)	pH	Berry wt. (g)	Antho-cyanins (mg/cm^2)
Chardonnay	VSP	Up	22.8 a	7.4 a	3.49 a	1.3 a	--
	Smart-Dyson	Up	23.4	7.1	3.48	1.3	
		Down	23.3	7.4	3.53	1.3	
		Total	23.4 a	7.2 a	3.51 a	1.3 a	--
	Smart-Henry	Up	22.8	7.2	3.49	1.3	
		Down	23.1	7.0	3.52	1.2	
		Total	23.0 a	7.1 a	3.51 a	1.3 a	--
Merlot	VSP	Up	22.0 a	6.2 a	3.52 a	1.3 a	0.61 a
	Smart-Dyson	Up	22.1	6.2	3.49	1.3	0.64
		Down	22.3	5.9	3.55	1.3	0.61
		Total	22.2 a	6.1 a	3.52 a	1.3 a	0.62 a
	Smart Henry	Up	22.4	6.2	3.50	1.3	0.68
		Down	22.4	6.0	3.50	1.3	0.68
		Total	22.4 a	6.2 a	3.50 a	1.3 a	0.68 a

[z] Numbers followed by the same letter within columns and for each cultivar are not significantly different at the 5% level (DMRT).