AMERICAN VINEYARD FOUNDATION
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Project Title: Wine Grape Canopy Management Practices in the San Joaquin Valley

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Objectives:

1. To evaluate the effects of leaf removal and hedging treatments on the canopy light microclimate, fruit composition, and vine yield of cultivars important to the San Joaquin Valley.

2. To evaluate leaf removal effects on bunch rot incidence.

3. To ultimately recommend to San Joaquin Valley wine grape growers and vintners grapevine canopy management practices which are most effective (but suited to our environmental and economic conditions) in achieving optimum quality and economic returns.

Time Table:

1992 - conduct leaf removal practices study at UC KAC.
1993 and 1994 - continue studies with emphasis on training and mechanized pruning systems.

Summary:

Recent wine grape vine training and trellising studies in the San Joaquin Valley have demonstrated the influence of cordon height, foliage support wires, and quadrilateral training on vine yield, fruit composition, and wine quality. Concurrent studies in other districts have also demonstrated the beneficial effects of cluster exposure through leaf removal and other canopy management practices on grape composition and reduced fungal disease incidence. The purpose of this study was to determine the influence of several leaf removal techniques and shoot hedging on wine grape cultivars and trellis systems suitable to the San Joaquin Valley.

Three leaf removal treatments -- Hand, Window, and Hedge -- and a check, no leaf removal were compared with French Colombard and Barbera. Leaf removal increased fruit zone light exposure in French Colombard temporarily due to its continued vigorous growth. This resulted in no fruit zone light environment differences at veraison and harvest. There were no significant fruit composition or bunch rot effects from any of the treatments in this cultivar. Hand leaf removal

reduced vine yields, presumably due to berry loss from sun exposure soon after the treatment was imposed.

Greater treatment effects were measured with Barbera. This could be explained by the more extreme and persistent effects of leaf removal in this less vigorous cultivar. Window leaf removal increased sunlight exposure through veraison while hand leaf removal was effective through harvest. However, this improved fruit exposure was not accompanied by any benefits in fruit composition, including soluble solids, pH, or anthocyanin content. The only treatment effects on fruit composition were reduced berry weight and titratable acidity in the Window and Hand treatments, respectively. The only positive effect was a reduction in bunch rot incidence from all of the leaf removal treatments as compared to Check. This included Hedge which did not improve fruit zone light environment at any time. This would suggest that hedging may provide adequate air circulation to reduce bunch rot while not changing the fruit zone light environment.

Overall, the results further demonstrate that canopy management leaf removal has the potential to reduce bunch rot in the San Joaquin Valley. However, the rapid regrowth of vigorous French Colombard may reduce or eliminate this effect unless practiced at a later date during fruit ripening. The mechanical methods of Window and Hedge were as effective as Hand, cluster-region leaf removal in reducing rot. Thus, they would be preferable under San Joaquin Valley conditions due to economics.

Leaf removal did not improve fruit composition as has been reported in cooler, coastal region studies. In fact, some leaf removal methods reduced berry weight, and titratable acidity in Barbera and yield in French Colombard. This was especially true of the more severe Hand leaf removal treatment where fruit exposure in this hot region caused berry burn. Thus, leaf removal canopy management practices in the San Joaquin Valley can be recommended for bunch rot control but are of questionable, if not detrimental, benefit to fruit composition and yield.

Research Accomplishments:

The study was conducted on mature French Colombard and Barbera grapevines at the Kearney Agricultural Center in Parlier, CA. The vines were vigorous, own-rooted, furrow--irrigated, and had 8′ x 12′ vine and row spacing. Vine training was bilateral cordon at 41"; trellis design consisted of a single overhead foliage support wire at 53". Experimental design was a randomized complete block with 4 treatments replicated 8 times using 4-vine plots. The center 3 vine spaces in each plot were used for data collection.

The treatments evaluated in the study were as follows:

1. Check (untreated control)
2. Hand, cluster area: standard hand removal of all leaves from the basal node up to and including the node opposite the apical cluster on each shoot.
3. Window: simulated mechanical removal of several layers of leaves from both sides of the canopy exterior in the fruiting zone.
4. Hedge: simulated mechanical hedging of both sides of the vine canopy. The canopy was hedged 1 foot below the cordon wire (i.e. all foliage below this height was removed).

The leaf removal treatments were performed after fruit set on June 16, 1992, when berry diameter was approximately 5 to 6 mm. The hedging treatment was applied on July 2, 1992 following canopy closure and approximately 1 week prior to fruit softening.

The light microclimate within the fruit zone of each treatment was determined three times during fruit development. Measurements were taken 2 to 6 days after the treatments were imposed, at veraison, and near harvest. Light measurements were taken with a hand-held quantum sensor. Twenty-five individual measurements were collected at 10 cm increments along a horizontal transect just above the cluster region. The quantum sensor was positioned vertically (upward) during all measurements.

Harvests were performed on September 9 and 15, 1992 for Barbera and French Colombard, respectively. Berry samples collected at harvest were analyzed for °Brix, titratable acidity, malic acid, pH, berry weight, total phenols, and anthocyanins (Barbera only). The samples consisted of 100 berries per plot except for Barbera which involved 150 berries to include a 50-berry sample for anthocyanin analysis. Total yield and bunch rot incidence were also determined at harvest. Bunch rot was measured by separating and counting those clusters designated as showing rot, i.e. four or more adjoining berries showing decay.

Results and Discussion

Fruit zone light environment

The effects of leaf removal and hedging on the fruit zone light environment of French Colombard and Barbera grapevines are presented in Figures 1 and 2, respectively. Immediately following their imposition, the Hand and Window leaf removal treatments significantly increased sunlight exposure within the fruit zone of both cultivars. Significant differences in the distributionof exposure categories >10% of ambient PPFD were not obseerved among the treatment during the course of the experiment. However, leaf removal generally decreased the portion of the fruit zone exposed to <1% of ambient PPFD, and increased exposure within the categories of 1-2%, 3-5%, and 6-10% ambient PPFD. Due to continued canopy growth improvements in fruit zone light exposure as a result of leaf removal were temporary in French Colombard. No significant difference in fruit zone light environment was found among the treatments at veraison or at harvest for this cultivar. The Window leaf removal improved sunlight exposure in the fruit zone of Barbera through veraison, while the Hand leaf removal treatment effectively improved fruit zone light environment of Barbera through harvest. Hedging did not improve fruit zone light environment compared to the control treatment in either cultivar.

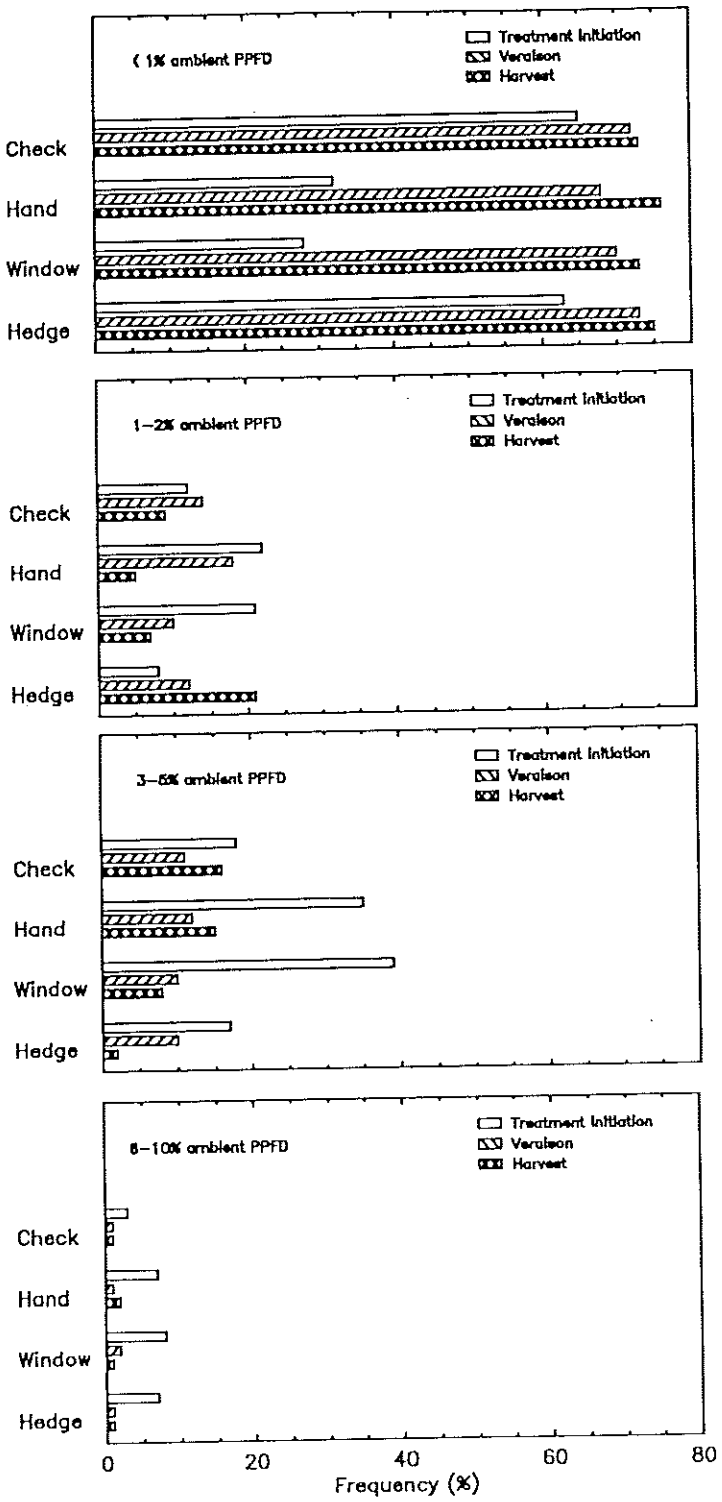
Fruit Composition and Yields

The effects of leaf removal and hedging on vine yield and fruit composition are presented in Table 3. The data indicate that the leaf removal and hedging treatments evaluated in this experiment had no positive effect on the fruit composition of either cultivar. Leaf removal had no significant effect on the fruit composition of French Colombard, while it reduced the berry weight (Window treatment) and titratable acidity (Hand treatment) of Barbera compared to the Check treatment. A significant reduction in yield resulted from Hand leaf removal on French Colombard. This yield reduction could be attributed to

excessive sun exposure of the developing berries. Sunburn damaged berries were noted within a few days after leaf removal in this treatment, and likely reduced berry number per cluster at harvest. There was a trend toward yield reduction from all leaf removal treatments on Barbera, but the differences were not significant. Bunch rot was significantly lower in Barbera for the leaf removal and hedging treatments compared to the Check treatment.

The results indicate that leaf removal did not improve fruit composition, and that some detrimental effects such as reduced titratable acidity (Barbera) may result. Leaf removal also reduced berry weight in Barbera and the yield of French Colombard due to excessive fruit exposure. On the positive side, bunch rot was reduced in Barbera as a result of leaf removal. The lack of reduced bunch rot form leaf removal in French Colombard is contrary to previous studies. However, the generally low incidence of bunch rot in this block in 1992 may have contributed these results. The Barbera results would indicate that all of the leaf removal methods were equally effective in reducing bunch rot. This would suggest that the mechanical hedging or windowing methods would be the most appropriate for the San Joaquin Valley because of the potential for mechanization. The cost of hand leaf removal may not be economical for many cultivars in the San Joaquin Valley.

This study of canopy management practices further demonstrates the benefits of leaf removal in reducing bunch rot. However, the results suggest that disease management may be the only positive benefit of leaf removal, as there were no benefits in improved fruit composition. In fact, the most severe, Hand leaf removal treatment in Barbera reduced fruit titratable acidity. This places into question the advisability of leaf removal in the San Joaquin Valley as is practiced in some of the cooler districts, at least from a fruit composition standpoint. The differences may be due to the hotter growing conditions of the San Joaquin Valley where the light and temperature effects of fruit exposure are more extreme as compared to the cooler coastal districts.



LSD ($P \leq 0.05$):

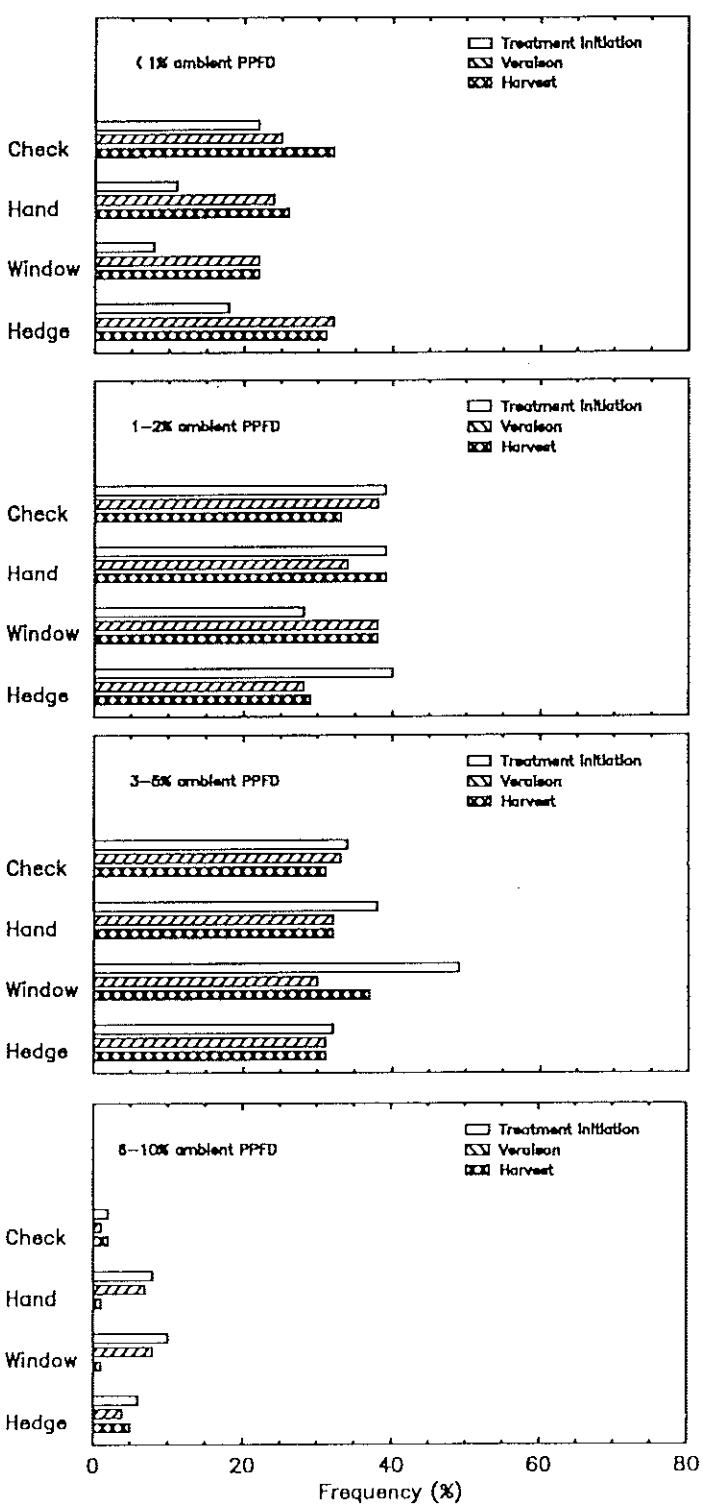
Treatment Initiation = 22
Veraison = 10
Harvest = 9

Treatment Initiation = 9
Veraison = 5
Harvest = 4

Treatment Initiation = 10
Veraison = 4
Harvest = 7

Treatment Initiation = 7
Veraison = 1
Harvest = 1

Figure 1. Influence of leaf removal and hedging on the fruit zone light environment of French Colombard wine grapes. Canopy light exposure categories are expressed as a percentage of ambient PPFD. LSD values ($p \leq 0.05$) for each exposure category are listed for the date of measurement and displayed adjacent to the graph. The treatments did not differ significantly in the distribution of light exposure categories > 10% ambient PPFD.



LSD ($p \leq 0.05$):

Treatment Initiation = 6
Veraison = 8
Harvest = 7

Treatment Initiation = 8
Veraison = 9
Harvest = 6

Treatment Initiation = 9
Veraison = 6
Harvest 8

Treatment Initiation = 3
Veraison = 3
Harvest = 2

Figure 2. Influence of leaf removal and hedging on the fruit zone light environment of Barbera wine grapes. Canopy light exposure categories are expressed as a percentage of ambient PPFD. LSD values ($p \leq 0.05$) for each exposure category are listed for the date of measurement and displayed adjacent to the graph. The treatments did not differ significantly in the distribution of light exposure categories > 10% ambient PPFD.

Table 1. San Joaquin Valley Wine Grape Canopy Management, 1992, Effects of leaf removal methods for French Colombard and Barbera on fruit composition and yield parameters, ANOVA results and treatment means

		Berry Analysis					Harvest Date		
Cultivar	Leaf Removal Treatments	Weight per berry, grams	Soluble solids °Brix	Titratable acidity g/100 cc	pH	Skin antho-cyanin content mg/cm^2	Yield per vine lbs.	% Yield of clusters w/rot	Number of clusters w/rot per vine
French Colombard	1. Check	2.49	19.7	0.84	3.54	-	75.25a	2.21	2.96
	2. Hand	2.43	19.7	0.83	3.58	-	62.31 b	1.48	1.96
	3. Window	2.48	19.3	0.87	3.54	-	75.48a	2.83	3.25
	4. Hedge	2.45	19.4	0.86	3.54	-	69.96ab	1.09	1.50
	p>F	.4994 n.s.	.3803 n.s.	.0922 n.s.	.1270 n.s.		.0250	.2246 n.s.	.1932 n.s.
Barbera	1. Check	2.53a	22.5	0.80a	3.45	0.199	78.70	6.53a	8.67a
	2. Hand	2.44ab	22.4	0.75 b	3.46	0.151	70.85	1.97 b	2.67 b
	3. Window	2.40 b	22.1	0.79ab	3.47	0.163	69.97	2.30 b	3.25 b
	4. Hedge	2.45ab	21.9	0.83a	3.44	0.140	69.17	2.57 b	3.79 b
	p>F	.0389	.7512 n.s.	.0295	.5454 n.s.	.1831 n.s.	.2246 n.s.	.0068	.0397