San Joaquin Valley Grape Symposium
MECHANICAL AND MINIMAL PRUNING IN WINEGRAPE PRODUCTION
January 16, 1996

Paul S. Verdegaal
UC Farm Advisor, San Joaquin County

The traditional goals of pruning are to:

1. Establish and maintain the permanent structure of the vine;

2. Distribute bearing wood according to the vine's capacity;

3. Regulate crop.

Experience and research shows that the benefits (simplicity, convenience and less need for thinning) of traditional hand pruning outweigh the problems (depressing effect of overall vine capacity, cost, etc.). In recent years, labor costs and grape prices have made the financial aspects of pruning more of a concern. The Australian experience demonstrates the feasibility of less or even no pruning to maintain production and quality while lowering costs.

Pre-pruning with machines to reduce the amount of wood to be pruned significantly decreases the amount of time and money spent on dormant pruning, but the need to lower costs or the concern of reliance on hand labor has encouraged many growers to experiment with various forms of machine pruning and minimal pruning. Sustainability of long-term yields and the effects of minimal pruning on fruit quality remain a question.

Beyond the use of trimmers or hedgers as a pre-pruning aid, there are three general levels of mechanized pruning systems:

1. hedging with hand clean up to a desired node number;

2. pruning to a hedge form (box or off-set rectangular); and

3. minimal pruning, cordon train (MPCT) vines.

Crop thinning by spring hedging can and should be included with MPCT to further regulate crop load. Crop thinning by harvest machine, 20-30 days post-bloom is also being investigated. Field experience of segments of the Australian industry in the irrigated, high production vineyards indicates mechanical or minimal pruning is a viable production system, both economically and viticulturally, even from the winemaker's view.

A review of some of the available literature shows a wide range of results, but common experiences do occur. Summaries of several studies are included as follows.

A comparison of three methods of pruning Gewürztraminer
J.H. Foott
California Agriculture; Vol. 41, No. 142, January-February 1987.

This three-year study evaluated the effects of standard spur pruning, cane pruning and simulated hedge pruning by machine on the variety Gewürztraminer in the central coast area of San Luis Obispo (Edna Valley). Differences were recorded in yield all three years, with mechanical pruning having higher yields than both spur and cane pruning, which were not different from each other, statistically. This difference lessened each year. There was no statistical significance in the effects on soluble solids, pH and total acidity.

Mechanical pruning of grapevine in Tuscany: observations on plant productivity and on some qualitative parameters of the fruits on Sangiovese and Prugnolo gentile vines.
G. Di Collalto and A. Fabbri
Riv. Vitic. Enol. 1990.

Over a five-year period, young vines produced more crop when mechanically pruned to a hedge compared to standard, cordon-trained vines. This was due to more, but smaller, clusters. Sugar levels were higher in standard pruned vines but not always significantly every year. Total acidity and pH were less affected. Color of fruit was generally less for machine pruned vines.

Vine response to increased node numbers
D.I. Jackson, G.G. Steams and P.C. Heamings
A.J. Enol. Vitic., Vol 35, No 3, 1984.

Six treatments ranging from 43 to 151 nodes per vine resulted in less shoots per vine with increased node counts, but more fruit from each shoot. Yield increase was due mainly to increased cluster numbers per vine. For the five varieties studied (Chardonnay, Gewürztraminer, Cabernet Sauvignon, Sauvignon blanc and Müller Thurgau), little differences were seen in cluster weights.

Update: Minimal pruning of cordon trained vines (MPCT)
P.R. Clingeleffer
Australian Grapegrower & Winemaker, April 1989.

Excessively vigorous vines were reduced in vigor, with increased yield, due to more clusters per vine. Berry weight was smaller and color more intense or equal to standard pruned vines. Sugar levels were less when harvested at the same time (3 to 4 °Brix less). Acid and pH were less affected, but MPCT fruit did have more acidity and a lower pH. Tasting scores were higher for MPCT wines.

The effects of mechanical pruning or pre-pruning on winegrape productivity and fruit quality.
F. Jensen, P. Christensen, R. Beede, and G. Leavitt
SJAR & EC Report, No. 9, 1980.

Machine pre-pruning, followed by hand pruning gave similar yields and fruit quality when compared on six wine varieties. Overall yields increased 9 percent with pre-pruning and minimal "clean up" pruning, while sugar levels were only reduced by 5 percent.

Some guidelines for mechanical pruning and harvesting wine grapes.
R.T. Simes and B. Panagiotopoulos
Australian Grapegrower & Winemaker, August 1987.

A few general guidelines from Australian experience are listed. Minimal pruning, hedge pruning and non-pruning are defined. Benefits such as reduced cost, more crop, better vegetative balance and more even cropping are compared to risks such as over-cropping, thinning and disease problems (powdery mildew and vine scale). In summary, mechanical pruning is working and more growers are using it each year.

Mechanical vine pruning in California.
H. Studer and M. Kliewer.
2nd International Seminar on Mechanical Pruning of Vineyard, Motta di Livenza (TV) Feb 15-20, 1988; Riv. Ing. Agr. (Quad No. 9)

A brief history of commercial use with mechanical pruning and its research is given. The development of the upright mechanical pruner is discussed. In summary, yields are increased but lower sugar levels are achieved, similar to results in Australia. Cordon trained vines only slightly improved fruit distributions. Although economically beneficial, wine quality is still a question and mechanical pruning is only slowly being adapted.

Proceedings of a mechanical pruning of grapevine workshop.
R.E. Smart and S.R. Kyloh, editors
Roseworthy Agricultural College and Australian Wine Board, May 20-22, 1980.

The current literature and research reports on the effects of mechanical pruning on yield, quality, costs, and even sociological implications include the following:

- Vigorous varieties and high vigor sites are more suited to mechanical or minimal pruning.

- Yields increased and soluble solids decreased, while total acidity and pH are less affected.

- Yield increase is due to increased cluster number, with cluster weights and berry weights becoming less when very high node number is achieved. These differences become less with time as vines adjust.

- Yield of mechanically pruned vines decreased nearer to standard vines after three years in many trials.

- Labor costs decrease substantially.

- More open canopy and balanced growth results in fruit quality as good as standard pruning in most cases and may even increase quality in some cases.

- Mechanical pruning is better suited with machine harvesting. With hedge pruning and MPCT system, machine harvesting is required.

- Fruit is more exposed and farther out from cordon. This can be a potential problem with some machine harvesting and/or may sunburn. Thinning by shoot trimming may be required to avoid over-cropping.

- Mechanical systems are better suited to a large block.

- Sufficient irrigation is needed to avoid stress and take advantage of higher yields.

- There is a delayed harvest due to slower sugar accumulation.

Current articles provide a brief review of California and Australian work but do not significantly address many other areas, such as Argentina (South America in general), South Africa and others.

Local interest in the northern San Joaquin Valley has only slowly been increasing. Mechanical pre-pruning followed by normal hand pruning is becoming more common. This allows normal pruning practices while reducing labor costs by as much as 30% to 50%. Abnormally dry winters have made pre-pruning with hand clean-up to normal bed counts fairly easy to accomplish. Continued rising costs, more labor regulations and concern of long term labor availability will make mechanized pruning systems a more likely alternative. More normal weather patterns with higher rainfall would also make mechanization more desirable to complete pruning quickly with shorter periods of vineyard access.

During the past five year, I have worked on three different pruning trials that incorporate mechanical or minimal pruning systems among the treatments. The following data have answered some questions and raised others. These trials are still in progress.

Sauvignon blanc Pruning and Training Trial
Kautz Vineyard, Lodi, California
1982 to 1991

The purpose of this trial is to compare several pruning and training systems in order to increase production and maintain quality. The trial was originally established in 1982 by A.N. Kasimatis and J.J. Kissler to help provide a strategy for increasing production, which had been very low, on this site. The vineyard was planted in 1978 as own rooted vines. The soil is a clay loam. Vines were trained to a bilateral cordon, with a 24-inch T at 60 inches.

The treatments include:

1	standard: 7, 2-node spurs per side	28 nodes
2	2x standard: 14, 2-node spurs per side	56 nodes
3	cane pruned: 4, 14-node canes	56 nodes
4	standard plus 2 kicker canes on trellis	56 nodes
5*	standard plus 2 kickers along cordon (long spur pruning)	56-80 nodes
6	machine hedge pruning	>80 nodes
7	quadrilateral 24-inch: 28, 2-node spurs	56 nodes

* In 1988, changed to long spur pruning with 3 to 4 nodes per spur and 14-20 spurs per side according to vine vigor. This simulates pre-pruning with hand clean-up. Approximately 56 to 80 nodes total.

Data was recorded on yield, cluster weights, cluster number, berry weight, soluble solids, total acidity, pH and most recently, pruning weights.

RESULTS

Results are very similar to Australian experiences. Yields have been increased with higher node numbers and soluble solids are decreased compared to standard pruning levels. Cluster number increase, cluster weight decreases, and berry weight decreases with machine pruned or high node count pruning. These cluster and berry differences lessen to some degree with time. Total acidity and pH are less affected.

Rot has not been a problem the last few years of drought, but some trends of less rot occur with higher node counts. Clusters are more exposed and farther out with machine pruned vines. Although the interior is shaded and no viable nodes found inside the canopy, farther out shoot growth and bud viability are good. The machine pruned vines seem to "self prune."

PSV

Pruning/Training Sauvignon blanc – 1991

	Treatment	Yield per vine (lbs)	Cluster No.	Cluster Wt. (lbs)	Rot (lbs)	Cl No.	% Rot	Berry Wt (g)	Brix	T.A. (g/L)	pH
1	Standard	34.9 d	87 b	0.40 A	1.01	3	2.97	1.59 ab	19.6 a	7.9 a	3.48
2	2x Standard	50.5 abc	124 cd	0.42 A	0.53	2	1.06	1.64 a	19.5 a	7.5 abc	3.41
3	Cane	43.9 cd	120 cd	0.37 AB	0.16	2	0.40	1.53 ab	18.3 ab	7.0 bc	3.43
4	Std/Kicker	48.5 bc	131 c	0.37 AB	1.19	3	2.47	1.53 ab	19.2 a	7.6 ab	3.43
5	Long Spur	56.4 ab	178 ab	0.33 AB	0.91	2	1.96	1.39 ab	16.7 b	6.9 bc	3.36
6	Machine	58.2 a	190 a	0.31 B	1.09	5	1.96	1.34 b	18.3 ab	6.7 c	3.43
7	Quad	54.3 ab	139 bc	0.39 AB	0.71	2	1.30	1.54 ab	18.8 a	7.5 abc	3.47
					ns	ns	ns				ns

Lower case letters indicate significance at 1 percent confidence level.
Capital letters indicate significance at 5 percent confidence level.

Pruning/Training Sauvignon blanc – 1992

	Treatment	Yield per vine (lbs)	Cluster No.	Cluster Wt. (lbs)	Rot (lbs)	Cl No.	% Rot	Berry Wt (g)	Brix	T.A. (g/L)	pH
1	Standard	40.2 B	121 B	0.33 AB	0.03 B	0.2 B	0.08 B	1.83 AB	24.6 A	5.3 BC	3.59
2	2x Standard	46.8 AB	130 B	0.37 A	0.08 B	0.4 B	0.08 B	1.90 A	22.8 B	6.1 A	3.51
3	Cane	38.4 B	132 B	0.29 BC	0.11 B	0.4 B	0.28 B	1.79 AB	23.2 AB	5.4 BC	3.58
4	Std/Kicker	48.4 AB	149 AB	0.33 AB	0.00 B	0.0 B	0.00 B	1.80 AB	23.3 AB	5.5 ABC	3.60
5	Long Spur	41.5 B	136 B	0.30 ABC	0.05 B	0.2 B	0.13 B	1.65 B	23.4 AB	4.9 C	3.53
6	Machine	45.4 B	174 A	0.26 C	0.01 B	0.2 B	0.03 B	1.72 AB	22.7 B	5.7 AB	3.54
7	Quad	57.7 A	175 A	0.33 AB	0.49 A	1.4 A	0.85 A	1.83 AB	23.7 AB	5.2 BC	3.62
											ns

Pruning/Training Trial
Sauvignon blanc Averages – 1982-91

	Treatment	1982	1983	1984	1985	1987	1988	1989	1990	1991	Avg Yield (lbs)
1	Standard	56.1	33.4	22.0	31.9	24.6	23.4	44.1	28.7	34.9	33.23
2	2x Standard	56.1	43.6	27.9	40.7	35.2	39.6	40.6	37.4	50.2	41.26
3	Cane	58.7	36.7	33.2	38.7	38.4	32.3	33.9	38.9	43.9	39.63
4	Std/Kicker	63.6	43.3	32.6	36.3	39.5	34.5	47.2	37.6	48.5	42.57*
5	Long Spur	46.6	37.4	24.0	32.6	34.7	33.5	49.6	48.1	56.4	40.32
6	Machine	67.8	61.6	43.1	55.0	45.8	68.6	55.9	45.2	58.2	55.69
7	Quad		32.6	33.0	43.6	38.0	37.2	63.4	39.5	54.3	42.70
										Treatment 5 1988-91*	46.90
										Treatment 5 1982-87	35.06

	Treatment	1982	1983	1984	1985	1987	1988	1989	1990	1991	Avg Brix
1	Standard	21.0	24.0	21.8	23.0	21.1	23.0	22.0	21.5	19.6	21.90
2	2x Standard	18.3	22.9	21.0	23.2	21.4	22.1	21.9	21.2	19.5	21.28
3	Cane	17.5	22.8	19.9	22.5	19.0	23.0	21.4	21.2	18.3	20.40
4	Std/Kicker	18.2	23.0	20.9	22.4	20.2	21.7	21.9	21.3	19.2	20.98
5	Long Spur	18.3	23.4	21.3	23.2	21.6	21.9	21.3	20.4	16.7	20.96
6	Machine	17.8	21.3	20.0	21.7	19.3	18.9	20.2	21.0	18.3	19.83
7	Quad		23.8	20.5	22.5	20.7	21.5	20.9	22.1	18.8	21.36
										Treatment 5 1988-91*	20.08
										Treatment 5 1982-87	21.66

* Treatment 5 changed from cordon canes to long spur pruning in 1988
Data from 1986 not available

Minimal Pruning Cordon Training Trial
1988-93

Objective: To determine the effects of a minimal pruning system that would reduce time and labor inputs of vine management and still produce quality fruit.

Cooperator: Mohr-Fry Ranches

Methods: A trial was established in 1988 to compare minimal pruning versus a standard level of pruning. Minimal pruning consists of training vines to a bilateral cordon, then allowing the vines to grow in their natural habit of many small shoots and many small clusters. This results in some shading out and "self-pruning". The large number of buds promotes many small-berried clusters located on the outer part of the canopy. Minimal can trimming is done to maintain shoots off of the ground and allow machine harvesting, which is a requirement.

This system and similar ones have been adopted in areas of Australia due to the scarcity of available labor. The purpose of this trial is to evaluate how to manage this type system and what effects there will be on vine growth, crop quality, yield, and pest problems.

There are 7 replications of 10 vines each, for a total of 140 vines in the trial. The vineyard is Cabernet Sauvignon on Freedom rootstock. Vines are spaced 7 x 11' on a vertical trellis and furrow irrigated.

The MPCT vines did overcrop the first year of conversion (1988). Clusters and berries were smaller, and there were considerably more than standard (20-22 spurs) pruning. In the third year (1990), as in the second year, MPCT vines had very small berries and lower sugar. Cluster numbers wee higher than standard. Yield was again comparable to standard but sugar levels were very much lower which is difficult to explain. Other juice components were not different.

After the installation of drip irrigation the yields for the standard vines were higher in both 1992 and 1993. For six years it appears yields do stabilize and the only major difference is in sugar levels. Juice composition even appears to be better in MPCT berries. Crop thinning will be necessary. this is being studied by both the Australian and New York industries.

Advantages:
Less labor is needed
Vigorous growth can be reduced
Smaller berries are produced (higher skin to volume ratio for color)

_: Shading of buds
Exposed clusters sunburned
Pivotal striker harvesting head needed

MINIMAL PRUNING TRIAL
1988-1993
Cabernet Sauvignon

	Treatment	Yield lbs	Cluster No	Cluster Wt lb	Berry Wt g	Brix	pH	T.A. g/L	Prunings lbs
1988	**MPCT**	45.6	563	0.08	0.70	20.4	3.17	6.7	0.28
	Standard	14.6	93	0.16	1.17	21.4	3.23	7.8	3.80
1989	**MPCT**	27.1	416	0.07	0.57	18.2	3.40	6.2	0.27
	Standard	29.9	139	0.21	1.12	20.8	3.52	5.0	4.10
1990	**MPCT**	22.5	189	0.12	0.90	21.9	3.69	5.6	0.09
	Standard	18.8	81	0.23	1.05	24.1	3.49	5.5	3.50
1991	**MPCT**	28.4	399	0.07	0.70	20.0	3.55	6.0	0.30
	Standard	22.9	89	0.26	1.28	23.3	3.47	5.9	4.80
1992	**MPCT**	34.9	384	0.09	0.80	21.3	3.57	5.6	0.40
	Standard	35.8	123	0.29	1.32	21.7	3.72	6.5	5.20
1993	**MPCT**	38.3	215	0.18	1.01	19.9	3.33	7.4	1.10
	Standard	49.3	116	0.43	1.28	20.4	3.41	7.7	5.80
1988-93	**MPCT**	32.8	361	0.10	0.78	20.3	3.45	6.3	0.41
	Standard	28.6	107	0.26	1.20	22.0	3.47	6.4	4.53

Drip irrigation installed 1992