

MECHANICAL PRUNING OF CORDON-TRAINED 'CONCORD' GRAPEVINES

J. R. Morris and D. L. Cawthon University of Arkansas, Fayetteville, AR 72701

'Concord' grapevines in Arkansas are predominantly trained to the Umbrella Kniffin system, which requires long cane pruning and tying of the selected canes to the lower trellis wire. Grape producers have expressed concern over the decreasing availability of qualified labor for pruning and tying and feel that this may necessitate abandoning some vineyards in Arkansas if pruning is not mechanized. Mechanization of pruning would require a trellis system which provides for cordon training, such as a single wire cordon or the Geneva Double Curtain (6) training system.

Mechanical pruning aids for 'Concord' were developed in Michigan (2) and New York (5,7). Completely mechanized pruning with no manual selection of canes was acceptable for 1 year on 'Concord' under New York conditions (5). The labor required to complete vineyard pruning operations was reduced following mechanical pruning (4,5). Arkansas vineyards can be converted from the existing Umbrella Kniffin system to shoot positioned single wire cordon or Geneva Double Curtain systems to facilitate mechanical pruning with no detrimental effects on fruit yields or juice quality (3). Preliminary research (4) in 1971 by the authors indicated that mechanical trimming of 'Concord' was possible and that no follow-up cane selection or node limitation was necessary under Arkansas conditions to maintain fruit yield and juice quality for the first year. Potential viticultural problems concerning the accumulative treatment effects, vine individuality, vineyard uniformity and lack of cane selectivity have been raised (4,7). The purpose of this study was to determine the effects of mechanized vine trimming in conjunction with manual cane selection and node limitation on 'Concord' production, juice quality and vine size in Arkansas.

MATERIALS AND METHODS

This study was conducted for 5 years (1974-1978) in an own-rooted 'Concord' vineyard established in 1957 at the Arkansas Agricultural Experiment Station, Fayetteville. Vines were spaced 2.4 m within the row and 3.1 m between rows. Trellis height was 1.8 m. Adjacent rows of single wire cordon (SC) and Geneva Double Curtain (GDC) trained vines were either 1) mechanically trimmed using a Wagner Pruning Aid' and all canes were trimmed each year to leave 4 to 6 node canes, or 2) balanced pruned on 5 node canes to a 30+10 schedule (30 nodes retained for the first 454g of cane prunings removed and 10 additional nodes retained for each additional 454g of prunings). Vines mechanically trimmed were either left untouched or were followed by hand pruning for cane selectivity and node adjustment to 60 or 90 per vine. All canes originating from the upper one-half of the cordons were manually removed each year at the time of pruning to establish all fruiting canes on the lower 180° sector of the cordon as described by Shaulis et al. (7). All vines were shoot positioned (current season's growth manually positioned vertically toward the vineyard floor) immediately after bloom and 2 more times on approximately 3-week intervals each year.

Uniform vines within each training system were selected. However, the size of GDC trained vines with a cordon length of 4.8 m was larger than SC trained vines with a cordon length of only 2.4 m at the beginning of the study, with an average vine size of 1.35 and 1.15 kg of cane prunings per vine, respectively.

The experiment was designed as a randomized block with 6 replications of 2-vine plots. Records were kept for individual vine yields and pruning weights. All treatments were imposed upon the same vines each year.

Fruit samples consisting of 3 whole basal clusters were collected at harvest from each plot and immediately frozen in polyethylene bags for later juice analysis. Grapes were harvested on 8/17, 8/25, 9/7, 9/6, and 9/1 in 1974-1978, respectively. For analysis, samples were thawed, destemmed, and berry wt., number of berries/cluster, and % green fruit (by count) were determined. Samples were blended for 15 sec in a laboratory blender, % soluble solids was determined on a Bausch and Lomb refractometer, and samples were heated for 1 hr at 85°C. After pulp was separated from juice using cheesecloth, a 5 ml aliquot of juice was diluted to 100 ml with distilled water, centrifuged, and optical density was read on a Bausch and Lomb spectrophotometer (model 340) at 520 nm. Another 5 ml sample of juice was diluted to 125 ml with distilled water and titrated to pH 8.4 with 0.1 N NaOH to determine acidity.

RESULTS AND DISCUSSION

Training and pruning effects on yield (Table 1) indicated that the Geneva Double Curtain (GDC) training system was generally more productive than the Single Curtain (SC) system. Mechanically trimmed vines with no node adjustment (no touch-up) were higher yielding than vines balanced pruned to a 30+10 schedule for the first year on GDC training and for the first 2 years on SC training. Low yields in 1976 were due to poor fruit set conditions. After this low yielding year and within a given training system, vines with 90 or more nodes retained following mechanical trimming did not produce significantly higher yields than 30+10 balanced pruned vines or vines limited to 60 nodes following mechanical trimming.

The near-failure of the 1976 crop did not allow a sufficient recovery period for the 90-node and no touch-up treatments, which were severely overcropped as indicated by the number of nodes which would have been retained if a 30+10 pruning schedule was used (Table 2). In 1974, vines left untouched following mechanical trimming retained approximately twice as many nodes as would have been left if a 30+10 balanced pruning schedule had been used. The

nodes per vine on the no touch-up treatments carried 3 to 4 times the number of nodes as would have been required by the theoretical 30+10 values after the initial year of the study. The 90 node vines averaged about twice as many nodes per vine and 60 node vines averaged only slightly more nodes per vine than would have been retained with 30+10 pruning.

Fruitfulness (fruit/retained node) generally decreased as the number of nodes per vine increased in all productive years after 1974 (Table 1). Vines with 60 nodes retained following mechanical trimming had node fruitfulness similar to 30+10 balanced pruned vines. The reductions in fruitfulness which occurred when 90 or more nodes were retained was due to decreases in both berry weight and the number of berries per cluster (data not shown).

Differences in pruning weights exhibited between balanced pruning to a 30+10 schedule and retaining 60 nodes following mechanical trimming were not significant during each of the 5 years and for the 5-year mean (Table 1). Vine size was reduced on both training systems after the first 2 years of pruning either to 90 nodes or by not adjusting node number following mechanical trimming. For the 5-year average, the GDC training system maintained larger vine size than the SC system, except for the no touch-up treatment. Frequently, canes on no touch-up vines did not mature and developed severe crowding along the cordon. In 1978, the comparatively low vine growth for all treatments in this study was exhibited throughout all non-irrigated vineyards on the University of Arkansas Experiment Station. The low vegetative growth for 1978 can be partially attributed to the cumulative effects of 2 consecutive years of high yield (1977 and 1978) and the fact that the 1978 growing season was extremely dry with only 12.4 cm of rainfall during the 85 days prior to harvest. In this experimental vineyard, mechanical trimming followed by a 60 node limitation maintained both yield and vine size comparable to the 30+10 balanced pruned vines.

Due to labor shortage, grapes were harvested in 1974 prior to development of acceptable quality on any treatment. The 1974 quality results, not reported here but previously published (4), indicated little difference between treatments. The 1975-78 results show that GDC trained vines pruned on a 30+10 schedule or to 60 nodes following mechanical trimming consistently developed at least 15% soluble solids each year (Table 3). Vines trained to the SC system responded similarly, but fruit from 60 node vines developed only 14.8% soluble solids by the time of harvest in 1978. The balanced pruned vines and vines limited to 60 nodes following mechanical trimming on both training systems consistently produced fruit with good color while there was a slight reduction in color development in juice from fruit on SC trained, 60 node vines in 1978.

Presence of green fruit at harvest is considered a serious damage defect by USDA Grades and Standards (8) and can result in fruit rejection at the processing facility. 'Concord' fruits produced in southern growing regions can ripen unevenly (1,3) and may be caused by stress induced by environmental conditions and fruit load. Vines in this study which were balanced pruned or limited to 60 nodes did not develop severe uneven ripening problems. The most severe uneven ripening occurred in 1977 on the SC, 90 and no touch-up treatments.

CONCLUSIONS

Regardless of the number of nodes retained within a given training system, yields were comparable during the final 2 years. But the vines with 90 or more nodes were reduced in size and would be considered over-cropped on this basis. Raw product quality of the juice from vines with 90 or more nodes was unacceptable indicating a response to the over-cropping. GDC training produced larger yields of acceptable quality fruit and maintained a larger vine size than SC training when vines were balanced pruned to a 30+10 schedule or limited to 60 nodes following mechanical trimming. Mechanical trimming followed by cane selection and node adjustment to 60 per vine maintained vine size and consistently produced fruit yields and juice quality comparable to vines balanced pruned to a 30+10 schedule. In relatively uniform vineyards which have been shoot positioned, mechanical trimming may be feasible when followed by cane selection and node limitation based on the general vigor of the vineyard. Since completely mechanized pruning with no follow-up cane selection or node adjustment appeared feasible for the first year of this study, the possibility of using a pruning cycle consisting of 1 year of completely mechanized pruning followed by a year of balanced pruning to a 30+10 schedule needs investigation.

Table 1. Effects of training system and pruning treatment on 'Concord' yield, node fruitfulness and vine size.

Treatment	Year					Mean
	1974	1975	1976	1977	197	
	<u>Yield (MT/ha)</u>					
GDC						
30+t0	7.2	15.6	3.2	20.2	19.4	13.1
60	8.9	74.2	2.3	19.7	16.9	12.4
90	12.8	13.5	6.2	18.9	20.9	14.5
No touch-up	16.1	18.3	7.5	23.7	22.3	17.6
SC						
30+10	5.4	10.8	4.3	14.1	15.6	10.0
60	8.0	11.4	4.6	18.8	17.5	12.1
90	11.1	13.0	6.2	14.6	15.2	12.0
No touch-up	10.3	21.2	6.7	16.1	13.4	13.5
LSD @ 5%	3.7	6.5	3.8	5.7	4.9	2.2
	<u>Fruitfulness (g/node)</u>					
GDC						
30+10	99.0	217.4	41.3	258.1	253.3	173.8
60	110.4	176.3	28.0	244.1	209.6	153.7
90	114.9	111.9	51.0	168.9	192.3	127.8
No touch-up	114.0	92.5	49.8	146.9	113.4	103.3
SC						
30+10	108.3	174.8	59.6	256.7	265.3	172.9
60	100.1	147.2	57.4	233.7	219.6	150.4
90	96.9	111.8	51.0	127.2	133.3	104.0
No touch-up	83.0	100.9	43.7	97.9	105.4	86.2
LSD @ 5%	NS	64.1	NS	52.4	49.4	21.3
	<u>Pruning wt. (kg/vine)^z</u>					
GDC						
30+10	1.51	1.94	1.54	1.70	1.10	1.56
60	1.52	1.79	1.49	1.56	0.89	1.45
90	1.02	0.95	1.11	1.25	0.50	0.97
No touch-up	0.74	0.40	0.98	0.80	0.44	0.67
SC						
30+10	1.16	1.45	0.91	1.27	0.69	1.10
60	1.52	1.52	1.04	1.09	0.69	1.17
90	0.97	0.77	0.79	0.91	0.49	0.79
No touch-up	1.18	0.43	0.70	0.79	0.54	0.73
LSD @ 5%	0.52	0.52	0.34	0.36	0.21	0.188

^zWeight of cane prunings per vine which were produced during the growing season of a given year.

Table 2. Number of nodes retained per vine and number of nodes that would be required using a 30+10 pruning schedule.

Training system and pruning trt.	1974		1975		1976		1977		1978	
	Nodes ^z retained	30+10 ^y value	Nodes retained	30+10 value	Nodes retained	30+10 value	Nodes retained	30+10 value	Nodes retained	30+10 value
GDC										
30+10	54	54	53	53	63	63	54	54	57	57
60	60	46	60	54	60	59	60	53	60	54
90	84	51	90	42	90	41	83	44	79	48
No touch-up	106	48	169	36	99	27	121	42	149	38
SC										
30+t0	37	37	46	46	52	52	40	40	48	48
60	59	47	60	54	60	54	60	43	59	44
90	85	47	87	41	90	37	83	37	86	40
No touch-up	95	49	165	46	119	27	122	35	101	37

^zNumber of nodes retained per vine for fruiting in a given year. Averaged across 6 replications and 2 vines per plot.

^yNumber of nodes per vine that would have been required if a 30+10 pruning schedule were used. Weight of cane prunings from previous growing season were used in calculations.

Table 3. Effects of training system and pruning treatment on % soluble solids, color and % green fruit in 'Concord' grapes.

Treatment	Year				
	1975	1976	1977	1978	Mean
GDC					
	<u>Soluble Solids</u>				
30+10	15.8	16.5	16.4	15.5	16.1
60	15.2	16.4	15.1	15.3	15.5
90	14.5	16.1	14.8	14.0	14.9
No touch-up	12.4	14.8	15.1	13.4	13.9
SC					
30+10	15.8	16.3	16.0	16.1	16.1
60	15.7	17.0	15.6	14.8	15.8
90	14.6	16.1	14.0	14.2	14.7
No touch-up	13.9	15.3	14.9	14.7	14.7
LSD @ 5%	1.3	1.2	NS	1.6	0.7
GDC					
	<u>Color (O.D. @520 nm)</u>				
30+10	.241	.272	.239	.214	.242
60	.243	.257	.252	.192	.236
90	.192	.232	.222	.145	.198
No touch-up	.134	.219	.201	.148	.176
SC					
30+10	.233	.291	.238	.211	.243
60	.243	.312	.211	.153	.230
90	.173	.261	.147	.151	.183
No touch-up	.150	.248	.177	.173	.187
LSD @ 5%	.066	.047	NS	.051	.027
GDC					
	<u>Green Fruit^z</u>				
30+10	0.3	0.6	1.6	0.0	0.6
60	1.2	0.5	2.2	0.8	1.2
90	1.1	0.4	5.1	1.3	2.0
No touch-up	7.6	0.8	4.7	0.4	3.4
SC					
30+10	2.4	0.4	2.0	0.7	1.4
60	2.3	0.4	5.8	1.5	2.5
90	1.8	1.0	27.3	3.1	8.3
No touch-up	3.2	1.6	23.7	6.8	8.8
LSD @ 5%	3.3	NS	17.1	2.2	3.6

^zPercentage of completely green fruit per cluster (by count).

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