Evaluation of Vertical Shoot Distribution on Canopy Shading, Yield, and Juice Quality of Concord and Niagara Grapevines

Report to the Kaplan Fund for 2003 Research

Investigators:

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Goal:

Evaluate the effect of vertical shoot distribution on the yield and quality of Concord and Niagara grapevines.

Treatments:

Mature Concord grapevines were pruned to 100 buds in three different configurations: 50 x 2 bud spurs, 20 x 5 bud canes, and 10 x 10 bud canes. Similarly, Niagara grapevines were pruned to 80 buds in three different configurations: 40 x 2 bud spurs, 16 x 5 bud canes, and 8 x 10 bud canes. Concord treatments began in 2000 and Niagara treatments began in 2001. Data were collected on yield, yield components, juice soluble solids, and vegetative growth.

Results:

There was a positive relationship between cane length and fruit yield on fixed node pruned Concord and Niagara grapevines in 2003. 100 node Concord and 80 node Niagara with long (10 node) canes yielded 13.1 and 13.0 tons/acre, respectively. In contrast, spur pruned vines yielded 8.2 tons/acre for Concord and 8.7 tons/acre for Niagara. The five node treatment was intermediate to the other two. Bud fruitfulness (yield/node) in the long cane treatment was greater than in the short cane treatment which explains for the yield differences at the same node number (Table 1, Table 2, Figure 1 A and B).

The results from the cane length experiment suggest that shorter cane pruning is inferior to long cane pruning (in yield) if the node number is held constant. Therefore, machine pruned vineyards with 5 node canes should leave roughly 15-20 % more buds to match the yield of 10 bud canes (for example: If a grower leaves 100 buds with long canes and switches to machine pruning, he should leave 120 buds with short canes to make up the potential yield difference because of cane length).

Mechanical pruning of Concord and Niagara for juice grape production is directed toward 5 bud canes and not 10 bud canes. This experiment was set up to determine if there is a yield or juice quality difference between long and short cane pruning. Although long cane pruning increased yield, it also decreased juice soluble solids in both Concord and Niagara. 2003 crop load studies at the Fredonia Vineyard Lab indicate that decreasing yield by 3 tons/acre will increased juice soluble solids by one degree brix. The effect of cane length on juices soluble solids can be explained by this yield – brix relationship (Figure 2 A and B).

As stated, long cane pruning has a higher yield at a given node number because of higher average bud fruitfulness. Greater bud fruitfulness could be a result of increased light exposure on the long canes or simply a result of different bud populations. Basal buds on Concord are less fruitful than mid-cane buds (Figure 3A). Therefore, leaving a greater population of mid-cane buds should lead to increased yield. In a similar experiment in the 1960's, Dr. Shaulis showed that basal bud fruitfulness could be increased by decreasing canopy density and increasing light exposure through GDC training. Pruning weights and the yield – brix relationship from 2003 do not indicate excessive canopy shading in any of the pruning treatments. Average pruning weight in Concord was below 2.7 pounds/vine and below 2.2 pounds/vine in Niagara. Canopy shading is generally not considered a problem until vine size is in excess of three pounds/vine. In addition, if canopy shading were a problem, there would not have been a linear yield-brix relationship (i.e. the lower yield in spur pruning would not have led to higher juice soluble solids).

Using Dr. Shaulis' 1964 data on bud fruitfulness along the length of a cane, the predicted yield for each of the 2003 cane length pruning treatments was calculated (Figure 3B). According to the historical data, the five bud canes should yield the highest because of a greater proportion of mid-cane buds. However, the current experiment does not agree with this calculation. Dr. Shaulis' experiment used 45 node/vine pruning while the current experiment uses 100 node/vine pruning. 45 nodes/vine would undoubtedly lead to high vegetative growth and increased internal canopy shading when compared to 100 nodes/vine. Therefore, it is possible that the pattern in bud fruitfulness along a cane would not be similar between the two experiments. In 2004, an effort will be made to characterize bud fruitfulness at each bud position along the length of a cane in each of the cane length pruning treatments.

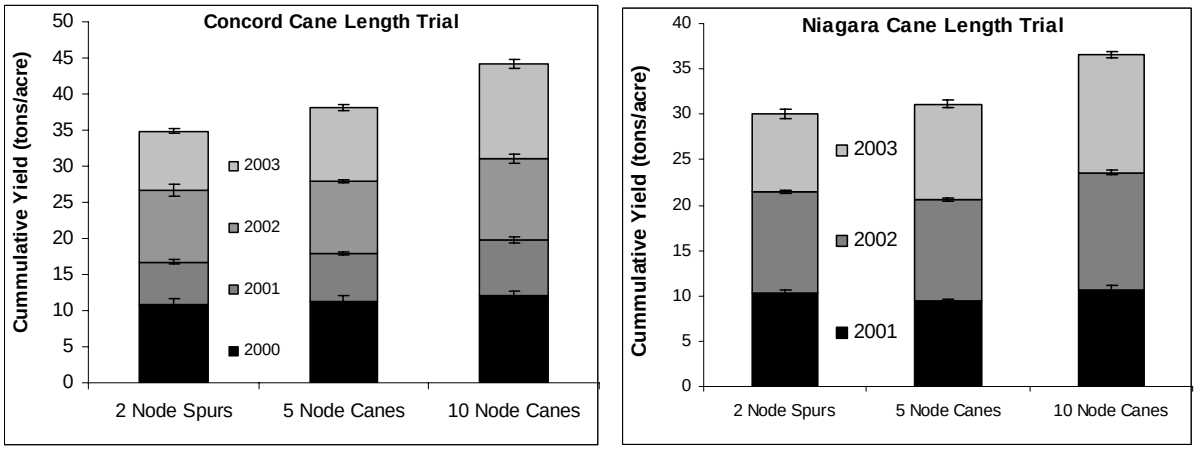

Figure 1 A and B. The effect of cane length on the cumulative yield of Concord (left) and Niagara (right) grapevines. bars = standard error for each year. n = 5 for Concord and 4 for Niagara.

Table 1. Vegetative and reproductive characteristics of 100 node Concord vines with different cane lengths. Different letters indicate a significant difference at the 5% level.

Year	Treatment	pruning weight	yield	clusters per node	cluster weight	berry weight	berries per cluster	juice soluble solids
	cane x bud	(lb.)	(TPA)		(g)	(g)		(brix)
2000								
	50 x 2	2.3a	10.8a	2.1b	77.2a	3.2a	24.3a	15.0a
	20 x 5	2.6a	11.2a	2.4a	71.3a	3.1a	22.8a	14.9a
	10 x 10	2.5a	12.1a	2.5a	71.5a	3.2a	22.6a	14.7a
2001								
	50 x 2	2.3a	5.9c	1.6b	55.2b	3.6a	15.4b	17.2ab
	20 x 5	2.4a	6.7b	1.7b	59.7ab	3.4b	17.6a	17.3a
	10 x 10	2.0a	7.7a	1.9a	61.0a	3.4b	18.2a	16.8b
2002								
	50 x 2	3.0a	9.9b	2.1b	69.9a	3.2a	22.2a	15.6a
	20 x 5	2.8a	10.0b	2.2ab	69.0a	3.0b	23.5a	15.2a
	10 x 10	2.5a	11.3a	2.4a	71.4a	3.0b	24.2a	15.3a
2003								
	50 x 2	2.7a	8.2c	1.57b	79.3b	3.4a	23.3c	15.5a
	20 x 5	2.6a	10.1b	1.80b	84.9ab	3.1b	27.1b	14.6b
	10 x 10	2.3a	13.1a	2.10a	93.4a	2.9c	32.0a	13.8c

Table 2. Vegetative and reproductive characteristics of 80 node Niagara vines with different cane lengths. Different letters indicate a significant difference at the 5% level.

Year	Treatment	pruning weight	yield	clusters per node	cluster weight	berry weight	berries per cluster	juice soluble solids
	cane x bud	(lb.)	(TPA)		(g)	(g)		(brix)
2001								
	40 x 2	3.2a	10.2a	2.0ab	94.8a	3.7a	25.8a	14.6a
	16 x 5	3.0a	9.5a	1.9a	95.9a	3.7a	25.9a	15.0a
	8 x 10	3.0a	10.7a	2.2b	93.1a	3.8a	24.8a	14.4a
2002								
	40 x 2	2.8a	11.2b	1.8b	119ab	3.4a	34.7a	13.1a
	16 x 5	2.6a	11.1b	1.8b	120a	3.5a	34.0a	13.1a
	8 x 10	1.9b	12.9a	2.2a	113b	3.4a	33.1a	12.6a
2003								
	40 x 2	2.2a	8.7c	1.2c	133a	3.9a	33.7b	13.3a
	16 x 5	1.9b	10.6b	1.5b	134a	3.9a	34.4ab	12.5b
	8 x 10	1.6b	13.0a	1.7a	141a	36.8a	36.8a	11.8c

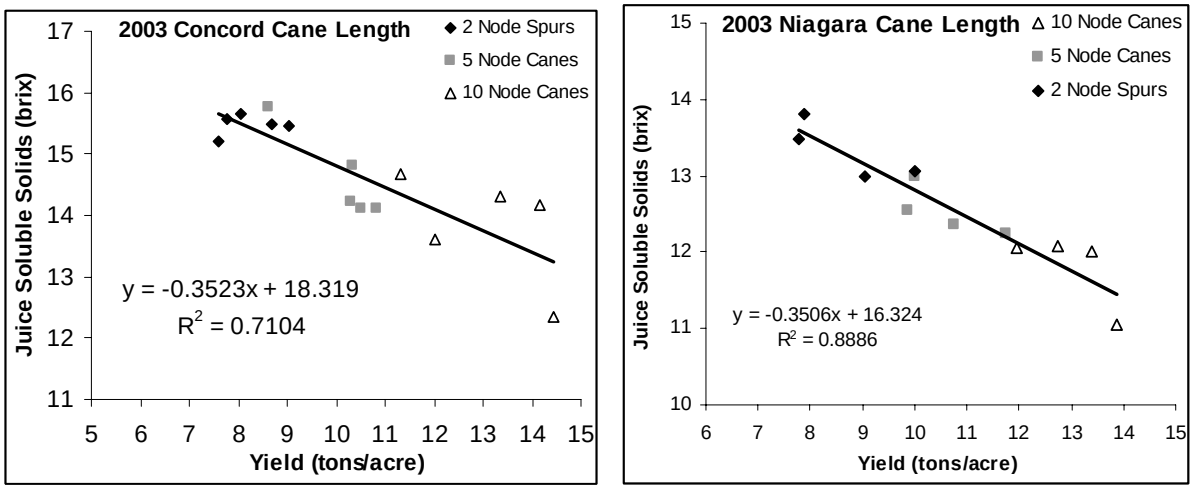

Figure 2 A and B. The 2003 yield – brix relationship for Concord (left) and Niagara (right). Increasing yield by increasing cane length also decreased juice soluble solids at harvest.

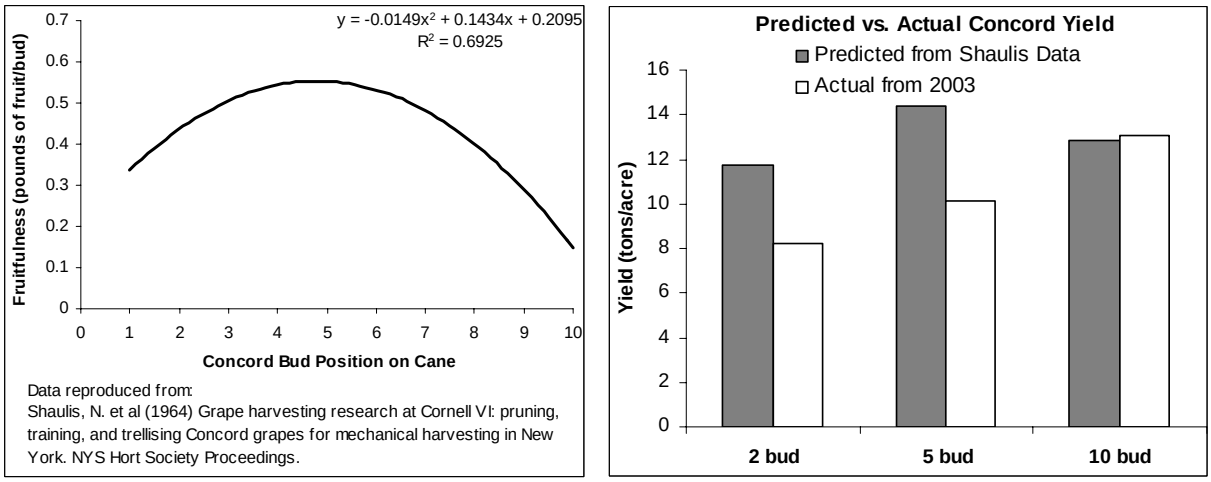

Figure 3 A and B. The relationship between bud position on a cane and fruitfulness (left). According to Dr. Shaulis' data, mid-cane buds on Concord are the most fruitful. The 1964 data was used to calculate the predicted Concord yield in the 2003 cane length trial (right).