MSU Agriculture Innovation Day

Focus on Fruit and Vegetable Technologies

Vineyard of the Future

Helping Michigan Concord Grape Growers Compete in a Shrinking Market

Concord juice prices have declined for decades while the input costs have risen. Yields have remained static. The architecture of Michigan's juice grape vineyards limits the yields of Concord grapes in Michigan. Typical juice grape vineyard are planted on 9 foot rows with vines 8 feet apart. The cordon height is about 5 feet to facilitate hand pruning of the cordon. The Vineyard of the Future looked a ways to increase Concord yields by taking advantage of increased mechanization of vineyard tasks.

A 5-acre experimental vineyard was planted at the MSU Southwest Michigan Research and Extension Center in 2011 to evaluate innovative modifications of Concord vineyard architecture. The vineyard raised the height of the trellis and cordon to 7 feet. It compared the traditional single wire cordon to adding a second cordon below the upper cordon at about 4 feet. It also compared own rooted Concord to vines grafted on SO4 rootstock.

A second trial compared the impact of vine spacing to see the influence of more or less vines per acre on yield.

A third planting compared different impact of different grafted rootstocks on yield.

The vineyard began production in 2015 and reached full production in 2015. 2017 was the third year of full production in this vineyard.

1. Raising the height of the vineyard increased yields.

In 2016, treatment yields ranged from10.7 to 13.8 tons/acre.

In 2017, yields of various treatments ranged from 13.7 to 20.4 tons/acre.

These yields are well above the long-term Michigan average yield of 5.5 tons/acre.

2. Despite the high yields the vineyard made minimum sugar.

In 2016, soluble solids ranged from 16.0 to 16.3 Brix and the commercial harvest of this vineyard averaged 17.1 Brix. In 2017, Brix ranged from 15.0 to 15.8.

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3. Increasing the number of Cordons and buds increased yields.
By increasing the number of cordon arms from 2 to 4 mechanical pruning left more buds on the vine. This difference was only significant in 2014, the first year of harvest. The trend is easy to see in the data. The Two Tier System consistently out produced the comparable Single wire system.

4. Grafted vines were more productive than own rooted vines
Because of vineyard variability this difference was not significant but the SO4 grafted vines consistently outperformed the own rooted Concord vines.

5. Vine spacing had little impact on yields.
Vine spacing had little effect on yields.

6. There was no clear winner between rootstocks.
While grafted vines did better than own rooted vines, yields among grafted vines were similar.

Figure 1. Average yield (tons per acre) of the four treatments over the experimental period 2015-2017.
A = Top Wire own rooted; B = Top Wire SO4 rootstock; C = 2 Tier own rooted and D = 2 Tier SO4 rootstock.

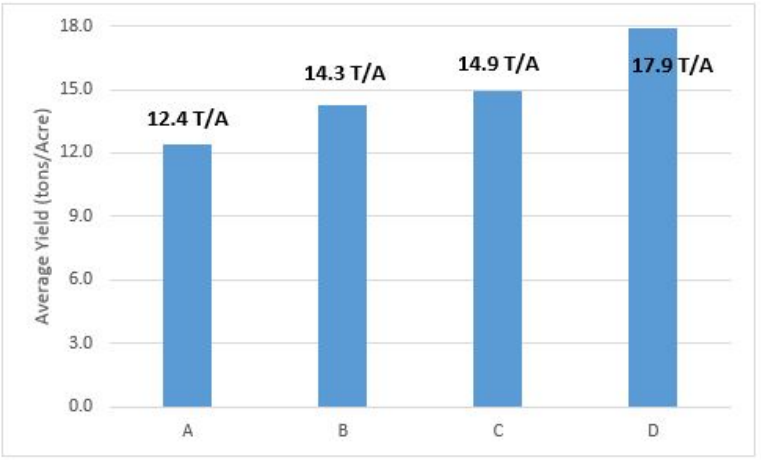

Table 1. Interaction between training system (Top wire or two tiers) and rootstock (own rooted and SO4)

YEAR	Treatment	Vine yield (Lbs)	Clusters per vine	Pruning weight (Lbs)	Brix	Tons/acre
2014	Top Wire ownrooted	9.3 b	43.4 b	4.5 a	16.2 a	3.2 b
	Top Wire SO4 rootstock	13.4 b	50.0 b	4.5 a	16.2 a	4.6 b
	2 Tier ownrooted	19.2 a	92.8 a	4.4 a	16.2 a	6.5 a
	2 Tier SO4 rootstock	24.4 a	94.8 a	4.8 a	16.5 a	8.3 a
2015	Top Wire ownrooted	37.6 b	157.3 b	3.8 a	14.7 a	12.8 b
	Top Wire SO4 rootstock	43.9 a	175.2 a	3.6 a	14.5 a	14.9 a
	2 Tier ownrooted	46.3 a	202.1 a	3.9 a	15.0 a	15.8 a
	2 Tier SO4 rootstock	58.1 a	221.6 a	3.7 a	14.3 a	19.7 a
2016	Top Wire ownrooted	31.5 a	136.0 a	2.9 a	16.0 a	10.7 a
	Top Wire SO4 rootstock	34.1 a	134.8 a	3.3 a	16.2 a	11.6 a
	2 Tier ownrooted	35.5 a	162.3 a	3.1 a	16.3 a	12.1 a
	2 Tier SO4 rootstock	40.4 a	173.6 a	3.3 a	16.3 a	13.7 a
2017	Top Wire ownrooted	40.4 b	163.4 b	2.7 a	15.2 a	13.7 b
	Top Wire SO4 rootstock	47.9 a	182.7 a	3.1 a	15.8 a	16.3 a
	2 Tier ownrooted	49.3 a	218.9 a	2.3 a	15.0 a	16.8 a
	2 Tier SO4 rootstock	59.9 a	242.2 a	2.6 a	15.2 a	20.4 a

Data were analyzed by one-way ANOVA, separately between years, with treatment as a fixed factor, and when the differences were significant, means were separated with Tukey's HSD test ($p < 0.05$). Different letters identify significantly different means.

Table 2. Impact of vine density (7, 8 and 09 feet between vines) on vine yield parameters and fruit quality (2016 fruit data were not provided).

YEAR	Treatment	Vine yield (Lbs)	Tons/acre	Clusters per vine	Pruning weight (Lbs)	Brix
2015	7	57.4 a	18.6 a	240.7 b	2.7 b	13.3 a
	8	63.9 a	19.4 a	263.5 b	3.1 b	13.6 a
	9	70.0 b	18.9 a	293.2 a	3.5 a	13.7 a
2016	7	36.7 a	11.9 a	175.5 b	2.5 b	
	8	41.0 a	12.5 a	190.8 b	2.9 a	
	9	44.5 a	12.0 a	205.8 a	3.1 a	
2017	7	50.8 a	16.5 a	226.2 a	2.4 b	14.9 a
	8	52.2 a	15.9 a	237.2 a	2.6 b	15.3 a
	9	50.6 a	13.7 b	225.2 a	3.5 a	15.9 a

Data were analyzed by one-way ANOVA, separately between years, with treatment as a fixed factor, and when the differences were significant, means were separated with Tukey's HSD test ($p < 0.05$). Different letters identify significantly different means.

Table 3. Impact of rootstock selection (420A Millardet et de Grasset; SO4 Selection Oppenheim; RG Riparia Gloire; MGT 101-14 Millardet et de Grasset and C330 is 3309C Couderc) on vine yield parameters and fruit quality (2016 fruit data were not provided).

YEAR	Treatment	Vine yield (Lbs)	Tons/acre	Clusters per vine	Pruning weight (Lbs)	Brix
2015	420A	65.9 a	19.7 a	275.0 a	2.5 b	13.4 a
	C330	66.4 a	19.8 a	269.9 a	2.7 b	13.5 a
	MGT	59.3 a	17.7 b	246.2 a	4.3 a	13.8 a
	RG	61.8 a	18.4 ab	256.5 a	2.8 b	13.6 a
	SO4	65.3 a	19.4 a	281.4 a	3.4 a	13.4 a
2016	420A	41.1 a	12.2 a	199.8 a	2.3 b	
	C330	43.3 a	12.9 a	196.7 a	2.5 b	
	MGT	38.4 a	11.5 a	179.8 a	3.9 a	
	RG	40.8 a	12.1 a	192.4 a	2.4 b	
	SO4	40.1 a	12.0 a	184.8 a	3.1 b	
2017	420A	52.9 a	16.4 a	243.8 a	2.2 b	15.3 a
	C330	51.3 a	15.8 b	227.2 b	2.6 b	15.3 a
	MGT	50.7 a	15.7 b	232.7 b	3.9 a	14.8 a
	RG	49.1 a	15.2 b	215.6 b	2.0 b	15.4 a
	SO4	51.2 a	15.9 b	221.6 b	2.9 b	15.1 a

Data were analyzed by one-way ANOVA, separately between years, with treatment as a fixed factor, and when the differences were significant, means were separated with Tukey's HSD test ($p < 0.05$). Different letters identify significantly different means.

Conclusions:
Currently, the per acre growing costs for Concord grapes are around $1,500 per acre and the price received by growers is about $200/ton, so that gross income on 5.5 tons/acre is about $1100. This means that growers need to produce about 8 T/A to generate any profit at all.

Raising the trellis from 5 to 7 feet dramatically increased yields, by 50% over the state average to over 12 T/A with the potential to generate $2,400 per acre.

Converting an existing vineyards trellis system would require replacing the posts and wires and retraining the vine to a higher cordon. If the existing cordon was left in place and another added above the potential yield would be almost 15 tons/acre with a gross income of $3,000/A