
SUMMARY OF EFFECTS OF ORGANIC AND CONVENTIONAL GRAPE PRODUCTION PRACTICES ON JUICE AND WINE COMPOSITION

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The overall objective of this study was to determine the impact of vineyard conversion to organic farming practices on juice and wine quality.

METHODS

Samples of fruit from organically and conventionally managed vineyards were tested for differences in composition. Juices and wines were analyzed for differences in color, pH, titratable acidity, sugar (soluble solids °Brix), individual organic acids, and potassium. Additionally, wines were analyzed for residual sugar content (glucose and fructose) and ethanol. Concord was hot-pressed as is common practice (hot-pressed at 65°C, 10 minutes). Since in Concord and Elvira sensory differences other than color and acidity are not considered important in current industry practice, the wines from these cultivars were not analyzed for further taste and aroma differences. Seyval Blanc is a major wine grape variety in North Eastern USA producing a wide range of wines with different qualities. Because of this Seyval Blanc wines were analyzed by taste panels for changes in aroma, taste and texture.

What follows are summaries of juice and wine analyses for the years 1990 to 1994.

1990

RESULTS OF JUICE ANALYSES

CONCORD

Juice and wine from the Concord grapes showed some significant differences in their composition as a result of the two different farming systems. The juice from the organically grown grapes was of better quality (higher maturity) than that from the conventionally grown grapes. It contained more sugar (Brix) and more color, it also had a higher acid content. The wine from the organically grown grapes still had a deeper color (conventional av. 0.408, organic av. 0.536, *s* 0.057) and a higher tartaric acid content (4.408 vs 4.048, *s* 0.064).

The higher maturity in the organically grown fruit is likely due to the lower cropping on these vines.

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Juice analysis, Concord (averages of four replicates)

Treatment	pH	TA g/L	Brix*	tartrate g/L	malate g/L	acetate g/L	K ⁺ mg/L
Conventional	3.24	8.5	13.8	3.96	3.01	<0.1	709
Organic	3.23	9.9	15.3	4.07	2.84	<0.1	783
Significance	none	0.07	0.02	none	none	none	none

Treatment	browning 420 nm	red 520 nm	hue 420/520 nm	brightness 420+520 nm
Conventional	0.093	0.188	0.498	0.281
Organic	0.148	0.280	0.547	0.428
Significance	0.000	0.020	none	0.002

* Brix: total soluble solids (sugars) by refractometer (g/100 mL)

ELVIRA

The juice analysis of the organically and the conventionally farmed grapes showed no consistent difference. Although the pH was lower and the higher content of tartaric acid in the organically farmed fruit might indicate a lower maturity, this is contradicted by the lower malic acid content and the trend to lower TA which both indicate higher maturity. There was no significant difference in the juice color although the juice and wine from the organically farmed grapes tended to be lighter in color. The pH of the wines was significantly lower for the organically grown grapes.

Juice analysis, Elvira (averages of three replicates)

Treatment	pH	TA g/L	Brix*	tartrate g/L	malate g/L	acetate g/L	K ⁺ mg/L	color 420nm
Conventional	3.36	9.6	14.4	3.75	4.45	<0.1	1079	0.174
Organic	3.15	8.5	13.2	4.22	3.03	<0.1	799	0.133
Significance	0.006	0.072	0.060	0.048	0.009	none	0.002	0.147

Wine analysis, Elvira (averages of three replicates)

Treatment	pH	TA g/L	alc. vol. %	tartrate g/L	malate g/L	acetate g/L	K ⁺ mg/L	color 420 nm
Conventional	3.23	8.89	10.8	1.79	3.88	0.33	555	0.121
Organic	3.01	8.35	11.4	2.42	3.41	0.25	374	0.087
Significance	0.005	none	none	0.209	none	none	0.004	0.155

SEYVAL

The chemical composition of juice and wine showed no major differences between the two treatments. There was a trend towards lower pH, higher TA and malate and tartrate in the organically grown fruit, indicating a somewhat lower maturity. Fruit from both growing systems had high acetate content indicating significant bunch rot in both systems.

Juice analysis, Seyval (averages of three replicates)

Treatment	pH	TA g/L	Brix* g/L	tartrate g/L	malate g/L	acetate g/L	K ⁺ mg/L
Conventional	3.04	9.54	11.3	3.12	2.95	0.44	678
Organic	2.94	10.1	14.0	4.40	3.22	0.43	746
Significance	0.021	none	none	none	none	none	none

Wine analysis, Seyval (averages of three replicates)

Treatment	pH	TA g/L	alc. vol. %	tartrate g/L	malate g/L	acetate g/L	K ⁺ mg/L
Conventional	3.00	9.63	10.2	3.10	3.75	0.33	652
Organic	2.92	9.36	11.3	3.18	3.02	0.33	434
Significance	none	none	none	none	0.074	none	0.087

Wine sensory analysis

The sensory analysis of the wines produced from the conventionally and the organically grown grapes showed only a small difference in the wine quality. Comparing all the attributes which were rated by the tasters, the wine from the organically grown grapes was rated slightly better than that from the conventionally grown grapes ($p=0.06$, multivariate analysis of variance, Wilk's Lambda), fruitiness was rated higher in the conventional wine ($p=0.002$). There was no difference in the overall quality as perceived by the tasters, nor in the wines' floral, spicy, sweetness, acidity, earthy, and vegetative characteristics, nor in body and length of finish.

1991 RESULTS OF JUICE ANALYSES

CONCORD

There were no significant differences between the juices from the conventionally and the organically grown Concord grapes. The differences indicated by the average values for each treatment were not significant due to a somewhat large variation between replicate samples. Still, these differences indicate only a small difference in the juice quality, the juice from the organically grown grapes had a higher sugar content but also a higher acetate content which indicates a higher percentage of rotten fruit in these grapes. This concentration of acetic acid is close to the taste threshold (0.4 g/L) which some individual samples exceeded. Importantly, there was no difference in the color quality of the grapes.

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Juice analysis, Concord (averages of three replicates)

Treatment	pH	TA g/L	Brix* g/L	tartrate g/L	malate g/L	acetate g/L	K ⁺ mg/L	color 420 nm 520nm
Conventional	3.22	6.83	13.3	4.46	1.44	0.04	999	0.109 0.108
Organic	3.30	6.72	14.6	4.01	1.02	0.28	1100	0.087 0.101
Significance	none	none	none	none	none	none	none	none

ELVIRA

The organically grown Elvira grapes were of better quality, their sugar content was slightly higher, titratable acidity was higher and pH was lower, tartrate and malate content were higher. The acetic acid content in the conventionally grown grapes indicates more bunch rot in these grapes. The juice from the organically grown grapes was more brown (s=0.01).

Juice analysis, Elvira (averages of three replicates)

Treatment	pH	TA g/L	Brix* g/L	tartrate g/L	malate g/L	acetate g/L	K ⁺ mg/L	color 420 nm
Conventional	3.53	5.76	15.8	2.9	1.08	0.77	853	0.143
Organic	3.17	6.98	16.3	3.26	1.82	0	945	0.277
Significance	0.013	0.084	0.033	0.029	0.031	0.025	0.018	0.01

SEYVAL BLANC

The organically grown Seyval Blanc grapes were more mature than the conventionally grown grapes, sugar content was higher and acid content lower. The juice from the organic grapes as in the Elvira tended to be browner.

Juice analysis, Seyval (averages of three replicates)

Treatment	pH	TA g/L	Brix* g/L	tartrate g/L	malate g/L	acetate g/L	K ⁺ mg/L	color 420 nm
Conventional	3.03	11.43	19.9	3.68	2.93	0	1062	0.065
Organic	3.03	9.95	21.8	4.04	2.25	0	878	0.219
Significance	none	0.007	0.049	none	0.068	0	0.269	0.09

Wine sensory analysis

1991 SEYVAL Wines

The statistical analysis of the sensory quality of the Seyval wines from the 1991 vintage shows only a very small difference between organically and conventionally managed grapes. The wines were rated by a taste panel for the following qualities: fruity, spicy, earthy, vegetative, body + mouthfeel, finish, sweetness, acidity, and overall quality. The wines differed in perceived earthy and spicy characters, not in overall quality.

The overall small difference between the wine from conventionally and organically managed vineyards is likely due to the very favorable growing conditions in 1991. Vines under both cultivation systems were able to mature a crop of good maturity that was essentially rot free.

Summary 1990 and 1991

Juice from Concord vines under organic management and conventional management showed no difference. Juice from Elvira vines under conventional management was of better quality than that from organically managed vines in 1990, whereas the opposite was true in 1991. There was no difference in juice or wine quality from Seyval vines on either management system in 1990. However, in 1991 Seyval juice from the organically managed vines was of higher quality than that from the conventionally managed vines. In general, better quality juice is associated with more mature crops which in turn are dependent on crop size and canopy size and function. Presently, there are no obvious trends favoring one management system over the other.

1992 RESULTS OF JUICE ANALYSES

CONCORD

The results of the juice analyses indicate that conventionally grown Concord grapes were slightly riper than the organically grown grapes. In the conventionally grown grapes, the pH was significantly higher. In addition, although not significantly, the sugar content tended to be higher and acidity tended to be lower (TA and tartaric and malic acid content). There was no significant difference in juice color.

Juice analysis, Concord (averages of three replicates)

Treatment	pH	TA g/L	sugar °Brix	tartrate g/L	malate g/L	acetate g/L	K ⁺ mg/L	color 420 nm	520nm
Conventional	3.21	11.9	13.1	3.13	3.35	0	340	0.062	0.234
Organic	3.17	13.1	12.4	3.60	3.66	0	392	0.088	0.276
Significance*	0.008	0.175	0.416	0.184	0.069	0	0.264	0.550	0.722

*T-test (n=3)

°Brix: measured by refractometer in g/100mL

TA: titratable acidity, expressed as tartaric acid

ELVIRA

There were no significant differences in the juice quality between conventionally and organically grown grapes.

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Juice analysis, Elvira (averages of three replicates)

Treatment	pH g/L	TA	sugar °Brix	tartrate g/L	malate g/L	acetate g/L	K ⁺ mg/L	color 420 nm
Conventional	2.91	17.8	11.8	4.55	6.79	0	746	0.101
Organic	2.83	19.3	11.3	5.01	7.06	0	737	0.87
Significance*	0.193	0.525	0.140	0.184	0.726		0.819	0.763

*T-test (n=3)

°Brix: measured by refractometer in g/100mL

TA: titratable acidity, expressed as tartaric acid

SEYVAL

Because of the high incidence and severity of bunch rot in 1992, grapes were separated into “clean” and “field run”. For the “clean” fraction the grapes were harvested from the replicate blocks and the bunch rot infected grapes were sorted out of each of the replicates. The clean sorted replicates were then processed and evaluated separately. For the “field run” samples, no selection of clean and infected fruit was made. These samples represent the grape quality as expected from mechanical harvest or hand harvest without selecting before processing. In situations with severe bunch rot, a processor may have to use additional labor to preselect the fruit in order to maintain good quality in juice and wine.

The juice from the non-selected, “field run” shows several differences in the quality of the conventionally and the organically grown fruit. The conventionally grown fruit was riper which is shown in a higher sugar content, higher pH, and lower acidity. There was no significant difference in the color of the juice. The fruit from both cultivation methods suffered from mold infections. The much stronger browning of the juices from the field run samples (mean 0.181 absorbance units at 420 nm) compared to that of the selected clean fruit (mean 0.038 abs. units) shows that this selection of clean fruit significantly ($s=0.013$, $n=6$) improved the quality of the juice from both cultivation practices. The clean sorted fruit from both treatments also had a significantly higher potassium content ($s=0.048$, $n=6$) and higher pH ($s=0.039$, $n=6$).

The chemical analyses of the juices from the clean fruit showed no difference based on the farming practices.

Further differences between the organically and the traditionally grown fruit and the selected and non-selected fruit can be expected in the sensory quality of the wines.

Juice analysis, Seyval, field run, non-selected fruit with bunch rot infection (averages of three replicates)

	pH	TA	sugar	tartrate	malate	acetate	K ⁺	color
Treatment		g/L	°Brix	g/L	g/L	g/L	mg/L	420 nm
Conventional	2.92	11.4	15.5	4.01	3.73	0	773	0.131
Organic	2.84	12.9	13.3	4.18	3.89	0	677	0.23
Significance*	0.033	0.103	0.007	0.096	0.687	0	0.079	0.270

*T-test (n=3);

°Brix: measured by refractometer in g/100ml;

TA: titratable acidity, expressed as tartaric acid

Juice analysis, Seyval, selected clean fruit (averages of three replicates)

	pH	TA	sugar	tartrate	malate	acetate	K ⁺	color
Treatment	g/L	°Brix	g/L	g/L	g/L	mg/L	420 nm	
Conventional	2.82	13.2	14.7	3.82	3.67	0	557	0.020
Organic	2.86	12.4	13.9	4.29	3.86	0	636	0.054
Significance*	0.926	0.233	0.173	0.177	0.388	0	0.481	0.164

*T-test (n=3)

°Brix: measured by refractometer in g/100mL

TA: titratable acidity, expressed as tartaric acid

Summary 1992

This year, as opposed to last year, the Concord grapes grown under conventional management were slightly riper in sugar and acid content than those farmed organically, yet there was no difference in juice color. There was no significant difference in the juice quality of the Elvira grapes from the organically and the conventionally farmed vineyard blocks. Because of the high incidence and severity of bunch rot (mainly powdery mildew, downy mildew, and black rot) it was decided to separate the fruit from both treatments 'clean' and 'field run' samples. For the 'clean' samples grape bunches free of mold infection were selected from each replicate. For the 'field run' samples no selection was made. These samples were intended to represent machine harvested fruit. The hand selection of fruit before processing might be chosen by a winery in order to work with high quality grapes. This practice of course adds significantly to the cost of the grapes. Analysis of the juice from the non-selected grapes showed that the grapes from the conventionally farmed vines were more mature with higher higher pH and higher sugar content. There was no significant difference in the amount of acetic acid, indicating that no secondary infection of the fruit by acetic acid producing bacteria and yeast occurred. The juice from the selected clean fruit showed no significant differences in quality from the two growing systems. The sensory analysis of the wines will tell whether there was a difference in the maturity of the fruit aromas. In the 1991 Seyval wines there were only two small differences in the sensory quality. The wines differed slightly in perceived spicy and earthy characters but not in overall quality. Overall, in the 1992 season, the fruit from the conventionally farmed vineyard was somewhat more mature.

1993 RESULTS OF JUICE ANALYSES

CONCORD

The most important difference between the juices from the two treatments is the much increased content of copper in the juice from the organically farmed grapes. These higher amounts of residue likely are a direct result of the increased use of copper under organic farming practice to control fungal infections. The organic blocks received four sprays with a total of 8 lbs/acre COCS 50WP, the conventionally farmed blocks received no copper sprays. Residual copper on the grape berry does enter the juice during the pressing of the grapes. The residual amount of copper in the organic juice is above the limit for copper in wine (0.4 mg/L) but there is no federal standard for copper concentration of grape juice. If this juice was fermented, the copper concentration would be reduced as up to 90% of the copper can be removed by adsorption to yeast.

Yield in the conventionally farmed blocks was much higher than in the organic, but it did not result in an apparent difference in fruit maturity. There was no difference in color, titratable acidity was lower in the organic fruit, yet sugar content, pH, and individual organic acids showed no change. Apparently, the conventionally farmed vines were able to ripen this higher crop load. The small difference in the potassium (K⁺) content can, with our current knowledge, not be related to the different farming practices. According to the petiole analysis, vines in both treatments were deficient in potassium.

Juice analysis, Concord (averages of three replicates).

Treatment	pH	TA g/L	sugar °Brix	tartrate g/L	malate g/L	acetate g/L	K ⁺ mg/L	Cu mg/L	color	
									420 nm	520nm
Conventional	2.84	10.8	13.5	2.51	0.98	<0.1	789	0.15	0.295	0.301
Organic	2.83	11.5	13.8	2.45	1.18	<0.1	863	0.55	0.281	0.300
Significance*	0.14	0.04	0.29	0.40	0.24		0.04	0.002	0.16	0.3

*T-test (n=3)

°Brix: measured by refractometer in g/100mL

TA: titratable acidity, expressed as tartaric acid

ELVIRA

As with the Concord juice, the most important difference is the different residual amounts of copper. The juice from the organically farmed grapes contained approximately twice as much copper than that from the conventionally farmed grapes. This difference can not be explained by different spray applications - there was no copper applied to the organic nor the conventionally farmed vines this season. Overall, there was no important difference in the fruit maturity. Small, statistically significant, differences in the juice quality show a trend that the organically grown fruit is riper than that from the conventional farming practice. The difference in the color indicates that the juice from the conventionally farmed grapes browned more easily. This difference might not be apparent in the wine since most of the easily oxidizable phenols precipitate during fermentation and clarification. These small differences in the juice quality are likely not important in the wine quality. There was no difference in the yield from the two farming practices.

Juice analysis, Elvira (averages of three replicates).

Treatment	pH	TA g/L	sugar °Brix	tartrate g/L	malate g/L	acetate g/L	K ⁺ mg/L	Cu mg/L	color 420 nm
Conventional	2.97	10.2	13.9	1.73	1.86	<0.1	845	0.20	0.147
Organic	2.81	9.6	14.5	1.88	1.50	<0.1	905	0.41	0.126
Significance	0.1	0.18	0.07	0.36	0.11		0.37	0.05**	0.10

*T-test (n=3) **T-test (n=2)

°Brix: measured by refractometer in g/100mL

TA: titratable acidity, expressed as tartaric acid

SEYVAL

Fruit from both farming practices had the same degree of fungal infection (approx. 10%) therefore, no fruit was selected out before processing. The chemical analyses of the juices indicates that the fruit from the organically managed vines was riper. The titratable acidity and malic acid content were lower, tartaric acid content was higher. There was a significant difference in yield from the two farming practices. The higher yield in the conventionally farmed vines might be responsible for the apparent lower maturity. Sensory analysis of the wines must confirm whether there is a difference in wine quality. The difference in the copper residue also indicates that higher residues are likely due to the organic practice. Copper was applied to the organically farmed blocks in mid-July (2 lbs/acre of COCS). The residue in the juice from the conventionally farmed grapes is surprisingly high considering that no copper spray was used in this block in 1993.

Juice analysis, Seyval, (averages of three replicates).

Treatment	pH	TA g/L	sugar °Brix	tartrate g/L	malate g/L	acetate g/L	K ⁺ mg/L	Cu mg/L	color 420 nm
Conventional	2.82	10.3	19.5	1.86	1.46	<0.1	934	0.46	0.138
Organic	2.82	8.97	19.7	2.26	1.05	<0.1	839	0.61	0.137
Significance	0.5	0.06	0.36	0.04	0.03		0.11	0.03	0.43

*T-test (n=3)

°Brix: measured by refractometer in g/100mL

TA: titratable acidity, expressed as tartaric acid

Results Of Wine Analyses For 1993

CONCORD

As anticipated, the small differences in juice composition which were apparent before fermentation were no longer apparent after fermentation and stabilization (and clarification) of the wines. Potassium content remains the only significant difference.

Wine analysis, Concord (averages of three replicates)

Treatment	pH	TA g/L	tartrate g/L	malate g/L	lactate g/L	acetate g/L	K ⁺ mg/L	Cu mg/L	color	
									420 nm	520nm
Conventional	3.16	0.99	1.84	0.71	0.23	0.24	421	0.30	0.25	0.49
Organic	3.16	1.04	2.05	0.82	0.25	0.23	789	0.33	0.33	0.62
Significance*	no	no	no	no	no	no	yes	no	no	no

*t-test; alpha = 0.05 (n=3)

Analysis done by t-test using Data Desk statistical analysis program

TA: titratable acidity, expressed as tartaric acid

ELVIRA

As in the Concord sample, the small differences apparent in the juices were no longer present in the wine. The lactic acid content in the wines from the two treatments is different. This is not due to an effect of the grape growing conditions but rather due to winemaking differences. Samples from the conventionally farmed grapes apparently underwent spontaneous malolactic fermentation (bacterial conversion of malic to lactic acid). Overall, the wines showed no difference due to the different farming practices.

Wine analysis, Elvira (means of three replicates)

Treatment	pH	TA g/L	tartrate g/L	malate g/L	lactate g/L	acetate g/L	K ⁺ mg/L	Cu mg/L	color	
									420 nm	
Conventional	3.56	1.03	1.01	1.44	1.08	0.44	516	<0.2	0.24	
Organic	3.25	0.97	0.81	1.12	0.08	0.33	421	<0.2	0.57	
Significance	no	no	no	no	yes	no	no	no	no	no

Analysis done by t-test using Data Desk statistical analysis program

*t-test; alpha= 0.05 (n=3)

TA: titratable acidity, expressed as tartaric acid

SEYVAL

The tartaric acid content remains the only difference in the wines. All other differences noted in the juices from the two farming practices did disappear with vinification. The wines were tasted by a “free choice profiling” method. The panel consisted of 8 experienced wine tasters. All samples were done in duplicate, and presented in a randomized order. The numerical values were based on a line scale with values ranging from a minimum of zero and a maximum of eight. In the sensory analysis, the wines were found to differ in spicy, skunky characteristics, the wine from the organically farmed grapes were judged in their overall quality slightly higher than that from the conventionally farmed grapes. This very small difference overall between the wines is certainly due to the very favorable growing conditions in this year. Vines under both cultivation systems were able to mature a good crop with low incidence of bunch rot.

Wine analysis, Seyval Blanc, (averages of three replicates)

Treatment	pH	TA g/L	tartrate g/L	malate g/L	lactate g/L	acetate g/L	K ⁺ mg/L	Cu mg/L	color 420 nm
Conventional	2.98	0.95	0.49	1.17	0.08	0.4	430	<0.2	0.12
Organic	2.92	0.87	1.09	0.94	0.07	0.25	406	<0.2	0.13
Significance	no	no	yes	no	no	no	no	no	no

*t-test; alpha=0.05 (n=3)

Analysis done by t-test using Data Desk statistical analysis program

TA: titratable acidity, expressed as tartaric acid

SENSORY TEST

SEYVAL BLANC

Treatment	Fruity	floral	spicy	earthy	vege- tative	Body/ mouthfeel	finish	flinty	skunky	overall
Conventional	3.8	2.5	3.1	2.3	2.1	3.9	4.1	3.0	4.7	3.5
Organic	4.2	2.7	3.2	1.7	1.8	3.9	4.1	3.2	2.5	4.7
Diff. @ 95%	no	no	yes	no	no	no	no	no	yes	yes

Summary 1993

Due to the very favorable growing conditions during this season, there was very little disease pressure and fruit from both farming practices was able to mature well without significant bunch rot. The most important difference is the clearly increased copper residue in the juice from the organically farmed grapes. With the necessity to rely solely on copper and sulfur sprays under organic farming practices to control fungal diseases we have to accept higher residual amounts of these substances in the juice and the wine. Higher residual amounts of sulfur can have an organoleptic impact (formation of H₂S during fermentation), the copper residues found in grape juice and wine can reach the legal limit in wine and cause haze formation. US Federal drinking water standard (1992) sets a tolerance of 1 mg/L for copper. There is no health concern from the copper residue found in the juices. (Note: In the juice analysis the sugar content was found to be

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significantly higher than sugar levels reported in Table 1.10 in the 'Yield' component of this report. We attribute this difference to be the difference in the sample size for each evaluation. In the 'Yield' component, 100 berries were taken from clusters from each hand harvested vine. In contrast, sugar levels obtained from the juice analysis component were a mixture of clusters taken from hand harvested vines throughout the sample plots.

1994 RESULTS OF JUICE ANALYSES

CONCORD

The most important difference between the juices from the two treatments is the much increased content of copper in the juice from the organically farmed grapes. These higher amounts of residue likely are a direct result of the increased use of copper under organic farming practice to control fungal infections. The organic blocks received four sprays with a total of 8 lbs/acre COCS 50WP, the conventionally farmed blocks received no copper sprays (last application was on 7/26/94; harvest was on October 3). Residual copper on the grape berry does enter the juice during the pressing of the grapes, especially with hot pressing. This amount of copper in the juices is below the legal maximum (0.4 mg/L in wine). It can be expected that this amount of copper is lowered during fermentation as up to 90% of the copper can be removed by adsorption to the yeast.

The organically grown Concord has higher acidity. This can indicate delayed ripening of these grapes.

Juice analysis, Concord (averages of three replicates)

Treatment	pH	TA g/L	sugar °Brix	tartrate g/L	malate g/L	acetate g/L	K ⁺ mg/L	Cu mg/L	color 420 nm 520nm
Conventional	3.52	0.49	16.8	1.32	0.61	<0.1	745	0.16	sampling error
Organic	3.34	0.84	17.2	1.80	1.27	<0.1	848	0.33	sampling error
Significance*	no**	no**	no	no**	Yes**	no	no	YES	

*t-test; alpha = 0.05 (n=3)

**t-test; alpha = 0.2 (n=3)

Analysis done by t-test using Data Desk statistical analysis program

TA: titratable acidity, expressed as tartaric acid

ELVIRA

Again, as in the Concord juices, the most important difference is the different residual amounts of copper. The juice from the organically farmed grapes contained approximately four times as much copper than that from the conventionally farmed grapes. The organic blocks received three sprays with a total of 9 lbs/acre copper sulfate (CuSO₄), (last application was on 7/27/94; harvest was on August 30). The juice from the conventionally farmed grapes also showed a relatively high copper content although these grapes had received no copper sprays. Overall there was no important difference in the fruit maturity evident in these analyses, sugar and malic acid content were similar in both treatments, yet the higher titratable acidity and tartaric acid content indicate a delay in ripening in the organically farmed grapes.

Juice analysis, Elvira (means of three replicates)

Treatment	pH	TA g/L	sugar °Brix	tartrate g/L	malate g/L	acetate g/L	K ⁺ mg/L	Cu mg/L	color 420 nm
Conventional	2.79	1.89	9.7	2.39	6.48	0.05	642	0.43	0.25
Organic	2.62	2.50	9.4	2.67	6.55	0.05	540	1.63	0.19
Significance*	no	Yes	no	no	no	no	no	Yes	no

*t-test; alpha = 0.05 (n=3)

Analysis done by t-test using Data Desk statistical analysis program

TA: titratable acidity, expressed as tartaric acid

SEYVAL

As with the other varieties, the copper residue is higher in the juice from the organically farmed grapes. This difference indicates that the increased use of copper sprays to control fungal disease on the grape vines does lead to higher residues in the juice. The organic blocks received three sprays with a total of 9 lbs/acre copper sulfate (CuSO₄), (last application was on 7/26/94; harvest was on September 9) and the conventionally farmed blocks received no copper sprays. There are no other significant differences apparent in these analyses.

Juice analysis, Seyval,(averages of three replicates)

Treatment	pH	TA g/L	sugar °Brix	tartrate g/L	malate g/L	acetate g/L	K ⁺ mg/L	Cu mg/L	color 420 nm
Conventional	2.93	1.16	14.9	2.11	3.17	0.05	555	0.5	0.15
Organic	2.87	1.27	15.3	2.13	2.81	0.06	642	1.23	0.15
Significance*	no	no	no	no	no	no	no	Yes	no

*t-test; alpha = 0.05 (n=3)

Analysis done by t-test using Data Desk statistical analysis program

TA: titratable acidity, expressed as tartaric acid

Wine Analysis 1994

Throughout the five years it has been practice for a panel to sample the wines six or more months after bottling. The 1994 wines, therefore, will not be sampled until a later date.

Summary 1994

Due to the growing conditions during this season, there was very little disease pressure and fruit from both farming practices was able to mature well without significant bunch rot. The most important difference is the clearly increased copper residue in the juice from the organically farmed grapes. With the necessity to rely solely on copper and sulfur sprays under organic farming practices to control fungal diseases we have to accept higher residual amounts of these substances in the juice and the wine. In organically produced Elvira and Seyval juice the copper residue was above the limit set by processors. For good manufacturing practice, large juice processors have set a maximum

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of 0.47 mg/L copper in single strength juice. Higher residual amounts of sulfur can have an organoleptic impact (formation of H₂S), the copper residues found in grape juice and wine can reach the legal limit in wine and cause haze formation. Fruit maturity was delayed in the organically farmed Concord and Elvira grapes.