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Effects on grape and wine quality of bunch thinning of Merlot under Queensland conditions

FINAL REPORT to
GRAPE AND WINE RESEARCH & DEVELOPMENT CORPORATION

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GRAPE AND WINE RESEARCH AND DEVELOPMENT CORPORATION

REGIONAL INNOVATION AND TECHNOLOGY ADOPTION (RITA) PROJECT

FINAL REPORT

PROJECT TITLE

Effects on grape and wine quality of bunch thinning of Merlot under Queensland conditions

REPORT PREPARED BY

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Contents

Abstract

Merlot is a major winegrape variety in Queensland, and is commonly crop-thinned locally due to potentially high cropping. Timing of crop thinning has been shown to influence quality. We investigated pea size and véraison crop thinning effects on Merlot yield and quality in the Granite Belt and South Burnett in 2008. Under seasonal conditions experienced, crop thinning did not bring about increased fruit quality. In fact, thinning at pea size may decrease quality. Thinning caused super-optimal leaf area / yield ratios, suggesting under-cropping. As crop thinning may not enhance quality, we recommend thinning only if crop loads are exceptionally high.

Executive summary

To date there has been little research on wine grape viticulture in Queensland. While an enormous amount of research data is available for other regions in Australia, findings from elsewhere may not be directly transferable to Queensland conditions. Certain factors make Queensland unique, e.g. a relatively wet growing season often with severe peak heat loads, with most vineyards at high altitude. Even within Queensland techniques may not be directly transferable due to local climatological variations. What is economically efficient in the Granite Belt for example may not be so in the South Burnett and *vice versa*. Research is needed to assist growers in each region to determine the optimum economic yield for each variety and how best to achieve it.

While there are many varieties grown in Queensland, some have emerged as proven performers and are already widely planted. A series of strategic meetings with members of the Queensland Wine Industry Association identified management of Merlot for quality fruit production as a major issue in need of investigation. Merlot has been shown to perform well in both the Granite Belt and the South Burnett, and is one of the top 5 winegrape varieties planted in Queensland. However, once established Merlot has a tendency to crop heavily and is often bunch thinned with the aim of promoting maturity and increasing berry quality. While it is generally considered that higher wine quality results from lower yield, controlled bunch thinning trials indicate both positive and negative effects, and there is some controversy over this issue. Timing of crop thinning has also been noted as a potentially important factor.

We investigated the influence of pea size and véraison crop thinning on Merlot yield and quality in the 2008 season in the Granite Belt and South Burnett regions.

It had been intended to harvest fruit when controls attained a total soluble solids level of approximately 13 °Baumé, however an unusually cool and overcast season resulted in slow ripening. Threatening inclement weather led to harvest at averages of 11 °Baumé at the northern site and 11.9 °Baumé at the southern site.

A significant reduction of vine yield by imposition of treatments resulted in all thinned vines having a leaf area to yield ratio (LA/Y) significantly higher, and yield to pruning weight ratio (Y/PW) significantly lower than controls. The significant increase in LA/Y by crop thinning caused the treated vines to have LA/Y greater than and Y/PW lower than those recommended as optimal. Vines were therefore out of balance and under cropped, with implications for successful fruit ripening. Thinning had no influence on vine vigour, berry or bunch size.

In the southern site, the total soluble solids (TSS) of the pea size thinned treatments were significantly lower than the control or véraison treatments, suggesting delayed ripening. The TSS of all groups at the northern site were similar. Despite any differences in TSS at harvest, the wines fermented to dryness from the various treatments had similar levels of alcohol, averaging 12.2 % (v/v) for the southern site and 11.1 % (v/v) for the northern site.

Delayed ripening was also indicated at both sites when pH and titratable acidity were considered. Pea size thinning resulted in fruit with lower pH and higher titratable acidity. Véraison thinned fruit had higher titratable acidity at the northern site but was similar to controls at the southern site. Despite these changes, thinning treatments did not significantly affect berry malic acid concentration.

Anthocyanin (colour) levels were marginally lower in pea size thinning at the southern site, but no differences were seen at the northern site. Total phenolics were significantly lower in both thinning treatments at the southern site, while no differences were seen at the northern site. In contrast, tannin levels were not significantly different at the southern site, while they were significantly decreased in véraison thinned fruit at the northern site. However, while statistically significant, the latter difference is marginal, with the variations within the data overlapping substantially.

Results of wine sensory analyses did not indicate any significant differences between treatments, however wines produced from thinned treatments were ranked slightly lower on a 20-point scale.

In summary, under the seasonal conditions experienced, reducing Merlot yield by bunch thinning resulted in vines being out of balance and did not lead to any consistent increase in fruit quality. Our data indicates that crop thinning at pea size may adversely influence quality.

This study indicates that the common practice of crop thinning Merlot may be economically detrimental, as wine production and sales volumes are decreased with no increase in quality and therefore no price premium.

It is anticipated that the experience with Merlot will be representative of other grape varieties; thus it is recommended that growers should be cautious only to thin if crop loads are exceptionally high.

Background

To date there has been little previous research of any sort on wine grape viticulture in Queensland. While an enormous amount of research data is available for other regions in Australia, much of it is not immediately applicable as there are certain factors that make Queensland unique. For example there is a relatively wet growing season often with severe peak heat loads and most vineyards are at quite a high altitude. Consequently findings from elsewhere may not be directly transferable to Queensland conditions.

Much of the Queensland industry is still in its infancy and while some viticultural techniques that are successful in other areas have been applied in Queensland, they have not been properly tested in this state. There is a need to test the cost effectiveness of alternative practices under regional conditions. Even within Queensland techniques may not be directly transferable due to local climatological variations. What is economically efficient in the Granite Belt for example may not be so in the South Burnett and *vice versa*.

Many Queensland growers are achieving very low yields compared to other Australian wine regions. The average for the State was less than 5 tonnes per Ha in 2005 compared to 8 – 10 tonnes per Ha for other premium districts or 15 – 20 tonnes per Ha in irrigated warm regions. Research is needed to assist growers in each region to determine the optimum economic yield for each variety and how best to achieve it.

While there are many varieties grown in Queensland, some have emerged as proven performers and are already widely planted. A meeting was convened in December 2006 by staff from the University of Southern Queensland and the Department of Primary Industry and Fisheries, to bring together representatives from the Queensland Department of Tourism, Fair Trading & Wine Industry Development, members of the Queensland Wine Industry Association and other individuals associated with the Queensland wine industry. The purpose of this meeting was to establish the industry's priorities for research and to ascertain how USQ and DPI&F would best be able to fulfil these needs. This group identified management of Merlot for quality fruit production as a major issue in need of investigation.

Merlot has been shown to perform well in both the Granite Belt and the South Burnett, and is one of the top 5 winegrape varieties planted in Queensland (11.7% in the Granite Belt in 2008, 7.6% in the South Burnett in 2006). However, once established Merlot has a tendency to crop heavily and is often bunch thinned with the aim of promoting maturity and increasing berry quality. While it is generally considered that higher wine quality results from lower yield, controlled trials indicate both positive and negative effects, and there is some controversy over this issue (reviewed in Jackson and Lombard 1993).

We conducted a pilot study in the 2007 growing season, focussing on crop thinning of Merlot. Significant results were obtained, providing important baseline information upon which the nature and scope of the research in this present study was formulated. Our preliminary trials in the Granite Belt and South Burnett regions of Queensland showed that the effects of bunch thinning Merlot can be quite variable and depend on the seasonal conditions for each region. Timing of crop thinning has been shown to influence grape quality (Filippetti *et al.* 2007). Therefore this investigation was carried out into the influence of pea size and véraison crop thinning on yield and fruit quality of Merlot in Queensland's Granite Belt and South Burnett regions in the 2008 season.

Project Aims and Performance targets

The primary purpose of this project was to research bunch thinning techniques for Merlot in the two main wine growing areas of Queensland, namely the South Burnett and Granite Belt. The project utilised the combined resources of all participants and other industry stakeholders to achieve maximum benefit for the Queensland wine industry.

The investigation compared the performance of Merlot in each region after bunch thinning at pea size, or bunch thinning at véraison, with un-thinned vines as a control. The two thinning treatment times were included to compare the potential benefits of common viticultural research practice (thinning at pea size) with common regional commercial practice (thinning at véraison). It was proposed to harvest each treatment or control in line with regional practice, at a target TSS of 13 °Baumé.

Data was recorded both during the season and at harvest, measuring vine performance and key juice quality indicators. To fully analyse the effect of viticultural practices on the end product, wines were made from the various treatments and subjected to analytical characterisation and sensory evaluation. The wines were made under standardised small lot conditions, and to reduce potential variability were not put through malolactic fermentation.

The data taken included vine measures (pruning weights, leaf area, shoot number, length and nodes, yield per vine, bunches per vine) fruit measures (bunch weight, berry weight, berry size, total soluble solids, titratable acidity, pH, and levels of malic acid, anthocyanins, tannins and total phenolics), wine composition (ethanol, titratable acidity, pH) ethanol levels and sensory analysis (preference, 20-point score).

It was proposed to conduct measures on 10 replicates of each treatment or control, and to combine replicates to make 5 replicates of each wine. Due to low crop levels at the Northern site, the number of replicates was increased to twelve. For each condition at each site, the 12 replicates were pooled in groups of 3 to make 4 replicates of each wine.

The analytical and sensory scores were subject to robust statistical analyses (using the SAS statistical package) to enhance the project outcomes.

The project was specified to be carried out over one vintage. Results have been disseminated via workshops to provide recommendations to growers that could be implemented in the short term, as well as establish a background for future research in Queensland in the long term. Conference, seminar and workshop presentations have been listed in Appendix 1. We are in the process of writing up the study for publication in the Australian Journal of Grape & Wine Research, and are also writing summary articles for the Queensland Wine Industry Association Newsletter.

The key focus of this study was to determine the economic cost/benefit and optimum timing for bunch thinning of Merlot in two major Queensland regions. In summary, the findings here question whether economic benefit is provided by crop thinning; any effects on quality are equivocal at best and detrimental at worst.

The intended outputs from this project included:

- production of research papers for publication in refereed journals as well as grape and wine industry periodicals (*articles are currently in preparation*)
- reporting of findings to the Queensland wine industry, GWRDC and the broader Australian wine industry in the form of a written report (*allied to this report, we will produce a report specifically for QWIA*)
- presentation of findings at events such as regional workshops and field days (*the presentations are listed under Appendix 1- Communications*)
- stimulation of further investigation into optimising grape and wine production for the Queensland wine industry, e.g. investigating other varieties, vineyard management and wine production options (*this project has led to formulation of several other projects, for which funding has been sought; a RITA grant (RT 08/03-1) was awarded in 2009 for the project "Addressing fruit exposure and sunburn in Queensland wine grape vineyards"*)

Performance targets:

July 2007 to January 2008: conduct thinning treatment at the phenological stages of pea size (E.L. stage 31) and véraison (E.L. stage 35), applying the same thinning treatments to vineyards in Queensland's two major wine grape growing regions. (*Completed in vineyards in the Granite Belt and the South Burnett.*)

January to March 2008: harvest the crops from thinned treatments and un-thinned controls at a target TSS of 13 °Baumé and to conduct vine measures and fruit analyses. (*Completed, see results section below*)

January to May 2008: produce small lot wines from thinned treatments and controls. (*Completed, see results section below*)

May and June 2008: conduct chemical and sensorial assessment on wines produced. (*See results section below. Sensorial assessment completed. Chemical analysis: ethanol, titratable acidity (TA) and pH were measured; residual sugar levels at the end of fermentation were zero by clinitest analysis. When opened for chemical analysis, the wines had partially undergone malolactic fermentation in-bottle, so it was not feasible to measure the other parameters. However, these measures were all completed on the harvested fruit, the main focus of the project.*)

July 2008: ascertain which of the applied treatment times, if any, is the more beneficial to fruit and wine quality, publish and promulgate results as noted above. (*Partially completed: results have been delivered via seminars, workshops and conferences with publication of abstracts, in June 2007, August 2007, June 2008 and November 2008 as listed in Appendix 1 - Communications. Journal and Newsletter publications are currently being prepared.*)

Methods

Two commercial Queensland vineyards were chosen on which to conduct this study – the northern site vineyard in the South Burnett and the southern site vineyard in the Granite Belt. Both vineyards were planted with *Vitis vinifera* cv. Merlot. The vines were 8 years old, trained to a VSP trellis with single bilateral cordons, and drip irrigated.

At each site approximately half the crop was removed from randomly allocated panels at pea size in one treatment group (12 replicate panels) and at véraison in another treatment group (12 replicate panels). At each site a control group (12 replicate panels) with no thinning treatment was included. All other typical management practices were maintained consistent for all treatments.

Vine measures were recorded at véraison. Shoot number, shoot length and node number and trunk circumferences were measured on the vines. Leaves were plucked from 5 shoots, and leaf area was measured using a Licor Biosciences LI-3100C leaf area meter (DPI&F Laboratories, Toowoomba).

Due to threatening inclement weather, the grapes from the northern site were harvested two weeks earlier than those from the southern site. At each site, all replicates were picked, processed and analysed on the same day.

Vine and fruit measures were performed at harvest, including bunch number per vine, yield (kg) per vine, bunch weight and berry weight.

Grape and wine analyses and winemaking were conducted in the laboratories and winery of the Queensland College of Wine Tourism.

Where not otherwise referenced, analytical measurements were conducted by standard methods as described in Iland *et al.* (2004). Total soluble solids were measured by refractometry, titratable acidity by titration, pH with a TPS AQUA-pH pH meter. Malic acid was measured using an enzymic test (Vintessential), anthocyanins by the AWRI Industry Standard Method (2006), tannins using the MCP (methyl cellulose precipitable) tannin assay (AWRI Industry Standard Method 2007) and total phenolics by A280 measurement.

Pruning weights were measured at pruning in the dormant season.

Small lot wines were made under standardised conditions from all treatments. Wine composition: ethanol was measured by ebulliometry, TA by titration and pH using a TPS AQUA-pH pH meter. Sensory analysis was conducted by the panel of five judges at the 2008 RASQ Wine Show in Toowoomba, on a standard preference, 20-point score.

All data were analysed for significant differences between the treatments using a single one way analysis of variance, with 5% LSD values calculated to determine which means were significantly different (using the SAS statistical software).

Results and Discussion

It had been intended to harvest fruit when controls attained a total soluble solids (TSS) of approximately 23.4 °Brix (13 °Baumé), however an unusually cool and overcast season resulted in slow ripening. Comparisons of climatic data are presented in Table 1. Threatening inclement weather led to harvest at an average of 19.9 °Brix (11 °Baumé) in the northern site and an average of 21.3 °Brix (11.9 °Baumé) in the southern site.

Table 1. Climatic data for the areas in which the trials were conducted.

Northern site climatic averages October - March				
Season	Rainfall (mm)	Mean January Temperature (ºC)	Mean max temp (ºC)	Mean min temp (ºC)
2005/06	423	31.7	30.6	16.9
2006/07	283	31.4	29.4	15.4
2007/08	573	27.9	27.5	15.8
2008/09	493	29.8	29.0	15.8
Southern site climatic averages October - March				
Season	Rainfall (mm)	Mean January Temperature (ºC)	Mean max temp (ºC)	Mean min temp (ºC)
2005/06	558	28.1	27.6	14.5
2006/07	329	28.8	26.4	13.3
2007/08	426	24.7	24.3	13.3
2008/09	435	26.9	25.7	13.7

The results for vine and fruit measures and analyses are presented in Table 2 and Table 3.

Table 2. Vine, fruit and wine measures for the Southern site. Where statistically significant differences ($p < 0.05$) were noted, the differences between each treatment group and the control were elucidated.

	Probability	Significantly different to control		Significantly different to each other	Control		Pea-size thinning		Véraison thinning	
		Pea	**Véraison**		**mean**	**SD**	**mean**	**SD**	**mean**	**SD**
Southern site										
TSS (°Brix)	0.0001	yes	no	yes	21.67	0.46	20.64	0.65	21.71	0.68
pH	0.0071	yes	no	yes	3.50	0.05	3.45	0.04	3.51	0.03
TA (g/L)	0.0003	yes	no	yes	6.67	0.36	7.45	0.54	6.47	0.72
Malic (g/L)	0.4251				2.35	0.26	2.33	0.26	2.22	0.26
Anthocyanins (mg/g)	0.0582	yes	no	no	1.18	0.21	0.97	0.21	1.12	0.21
Phenolics (A280/g)	0.0390	yes	yes	no	1.90	0.25	1.66	0.26	1.73	0.17
Tannin (mg/g)	0.0604				5.51	1.12	4.91	0.55	5.67	0.60
Trunk circumference (cm)	0.6936				9.45	1.30	9.21	1.57	8.96	1.30
Yield: Y (kg/vine)	0.0000	yes	yes	no	3.98	0.90	2.55	0.53	2.38	0.54
Shoots/vine	0.3200				23.50	3.71	24.25	3.67	26.17	5.52
Shoot length (cm)	0.1819				95.33	12.07	110.13	19.65	105.88	25.15
Berry wt (g)	0.6982				1.49	20.51	1.52	12.48	1.47	20.95
Bunch wt (g)	0.8672				119.11	20.51	119.90	12.98	122.94	20.95
Vine leaf area: LA (m^2)	0.3222				3.48	1.12	3.59	1.05	4.20	1.49
LA/Y (m^2/kg)	0.0057	no	yes	no	0.94	0.41	1.47	0.54	1.88	0.92
Pruning wt: PW (kg)	0.4287				0.50	0.09	0.56	0.10	0.53	0.14
Y/PW (kg/kg)	0.0000	yes	yes	no	8.20	2.40	4.60	0.95	4.60	1.00
Light (% ambient)	0.5200				17.58	12.99	15.11	9.37	12.62	8.64
Bunches / vine	0.0000	yes	yes	no	33.70	4.03	21.40	3.15	19.35	7.38
Wine alcohol %	0.9585				12.20	0.49	12.18	1.42	12.35	0.53
Wine score (/20)	0.2067				14.40	0.29	13.95	0.48	14.35	0.26

Table 3. Vine, fruit and wine measures for the Northern site. Where statistically significant differences ($p < 0.05$) were noted, the differences between each treatment group and the control were elucidated.

	Probability	Significantly different to control		Significantly different to each other	Control		Pea-size thinning		Véraison thinning	
		Pea	Véraison		mean	SD	mean	SD	mean	SD
Northern site										
TSS (°Brix)	0.2603				20.08	0.53	19.70	0.69	19.76	0.58
pH	0.0000	no	yes	yes	3.60	0.04	3.56	0.05	3.67	0.04
TA (g/L)	0.0016	yes	yes	no	4.23	0.21	4.47	0.14	4.40	0.10
Malic (g/L)	0.1311				1.24	0.32	1.06	0.14	1.21	0.20
Anthocyanins (mg/g)	0.8252				1.10	0.17	1.13	0.15	1.09	0.15
Phenolics (A280/g)	0.6661				1.55	0.23	1.64	0.24	1.56	0.28
Tannin (mg/g)	0.0150	no	yes	no	6.95	0.75	6.64	0.96	5.95	0.70
Trunk circumference (cm)	0.2073				9.67	0.96	9.88	0.91	10.33	0.89
Yield: Y (kg/vine)	0.0000	yes	yes	no	2.45	0.30	1.48	0.56	1.62	0.49
Shoots/vine	0.6282				41.25	6.51	41.92	5.99	43.83	7.69
Shoot length (cm)	0.5446				49.70	4.06	51.47	3.98	52.45	8.98
Berry wt (g)	0.6486				1.04	4.26	1.07	7.26	1.07	12.79
Bunch wt (g)	0.7759				40.55	4.26	40.83	7.26	41.82	12.79
Vine leaf area: LA (m^2)	0.4813				2.11	1.11	1.99	0.84	2.29	1.60
LA/Y (m^2/kg)	0.0078	yes	yes	no	0.88	0.20	1.51	0.41	1.56	0.45
Pruning wt: PW (kg)	0.1186				0.25	0.10	0.24	0.09	0.28	0.06
Y/PW (kg/kg)	0.0006	yes	yes	no	31.01	4.46	20.39	6.59	17.29	2.93
Light (% ambient)					N/A		N/A		N/A	
Bunches / vine	0.0000	yes	yes	no	165.00	16.64	98.58	31.95	102.92	19.77
Wine alcohol %	0.3010				11.28	0.32	10.95	0.33	11.18	0.17
Wine score (/20)	0.4416				14.40	0.36	13.83	1.15	13.80	0.29

A significant reduction of vine yield by imposition of treatments resulted in all thinned vines having a leaf area to yield ratio (LA/Y) significantly higher, and yield to pruning weight ratio (Y/PW) significantly lower than controls (Tables 2 and 3, Figures 1 and 2). The significant increase in LA/Y by crop thinning caused the treated vines to have LA/Y greater than and Y/PW lower than those recommended as optimal (Dry *et al.* 2004). Vines were therefore out of balance and under cropped, with implications for successful fruit ripening (Howell, 1999). Thinning had no influence on vine vigour, berry or bunch size (Tables 2 and 3), as also reported by Keller *et al.* (2005).

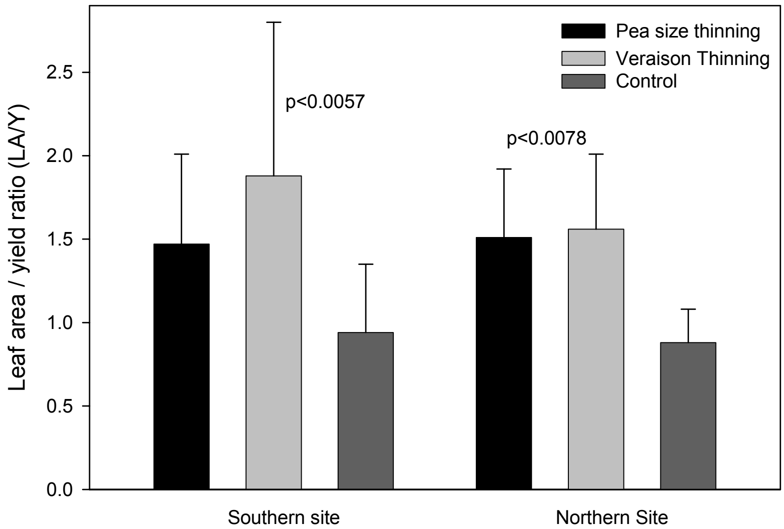

Figure 1. Effects of the different treatments on leaf area to yield (LA/Y) ratio.

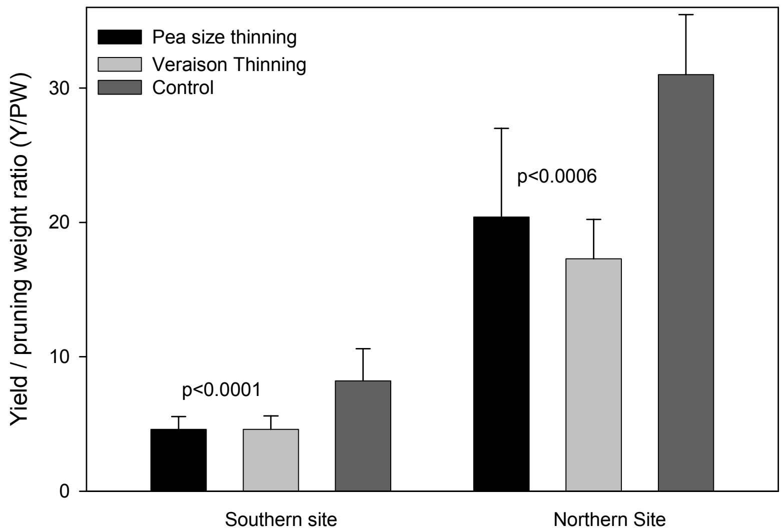

Figure 2. Effects of the different treatments on yield to pruning weight (Y/PW) ratio.

In the southern site, the total soluble solids (TSS) of the pea size thinned treatments were significantly lower than the control or véraison treatments (which were not significantly different to each other), suggesting delayed ripening. The TSS of all groups at the northern site were similar (Tables 2 and 3, Figure 3). Despite any differences in TSS at harvest, the wines fermented to dryness from the various treatments had similar levels of ethanol, averaging 12.2 % (v/v) for the southern site and 11.1 % (v/v) for the northern site (Tables 2 and 3).

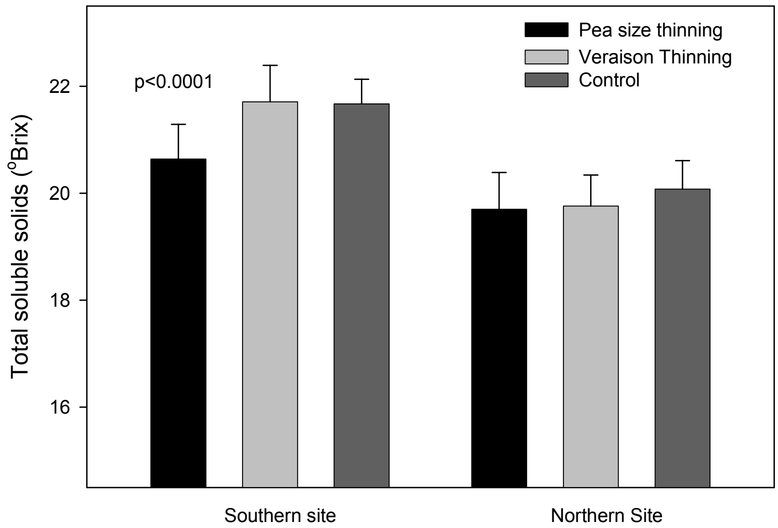

Figure 3. Total soluble solids (TSS) of grapes at harvest.

Titratable acidity and pH data suggested delayed ripening of pea size thinned treatments at both sites, resulting in fruit with lower pH and higher titratable acidity. Véraison thinned fruit had higher titratable acidity (although also, unusually, higher in pH) at the northern site but was similar to controls at the southern site (Tables 2 and 3, Figures 4 and 5). Despite these changes, thinning treatments did not significantly affect berry malic acid concentration (Tables 2 and 3).

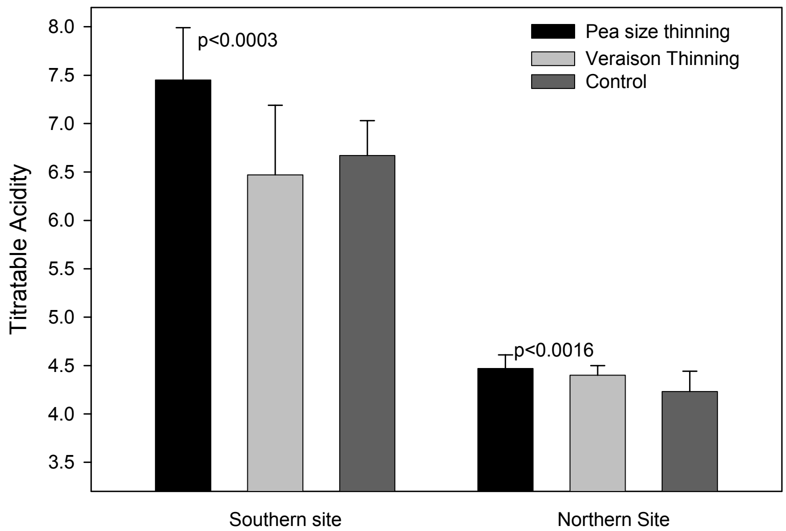

Figure 4. Titratable acidity (TA) of grapes at harvest.

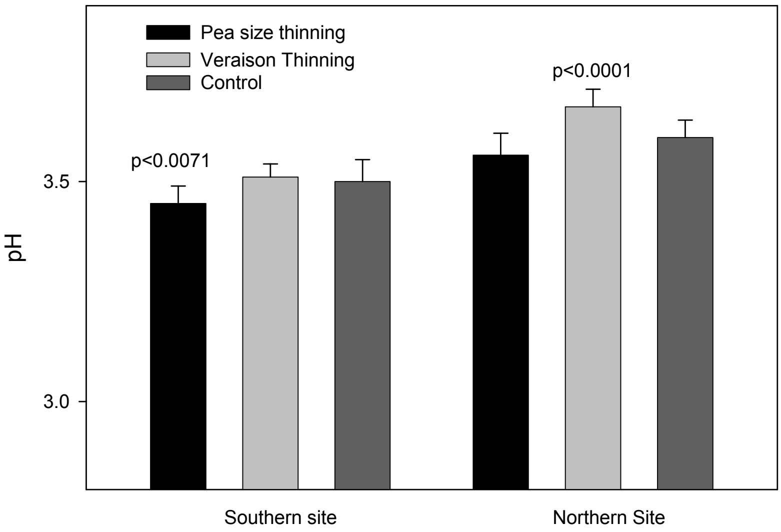

Figure 5. pH of grapes at harvest.

Anthocyanin (colour) levels were marginally lower in pea size thinning at the southern site, but no differences were seen at the northern site (Tables 2 and 3, Figure 6).

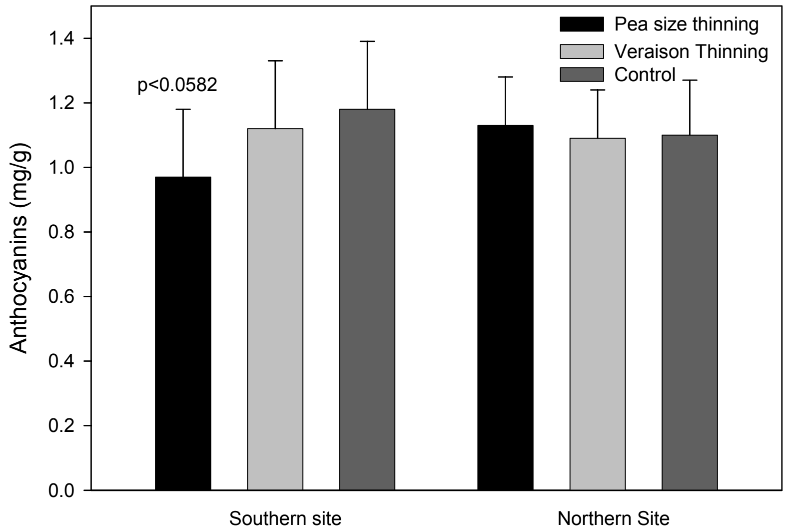

Figure 6. Anthocyanin (colour) levels of grapes at harvest.

However total phenolics, expressed as absorbance (A280) per g, were significantly lower in both thinning treatments at the southern site, while no differences were seen at the northern site (Tables 2 and 3, Figure 7).

In contrast, tannin levels were not significantly different at the southern site, while they were significantly decreased in véraison thinned fruit at the northern site (Tables 2 and 3, Figure 8). However, while statistically significant, the latter difference is marginal, with the variations within the data overlapping substantially.

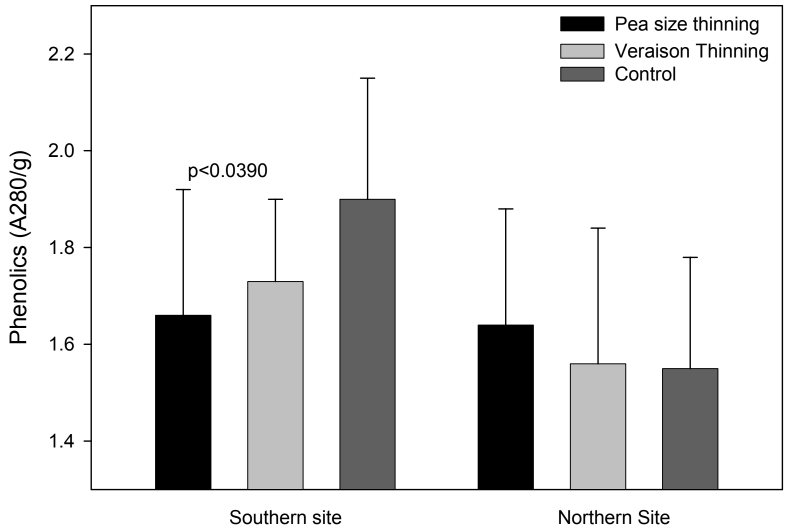

Figure 7. Total phenolic levels of grapes at harvest.

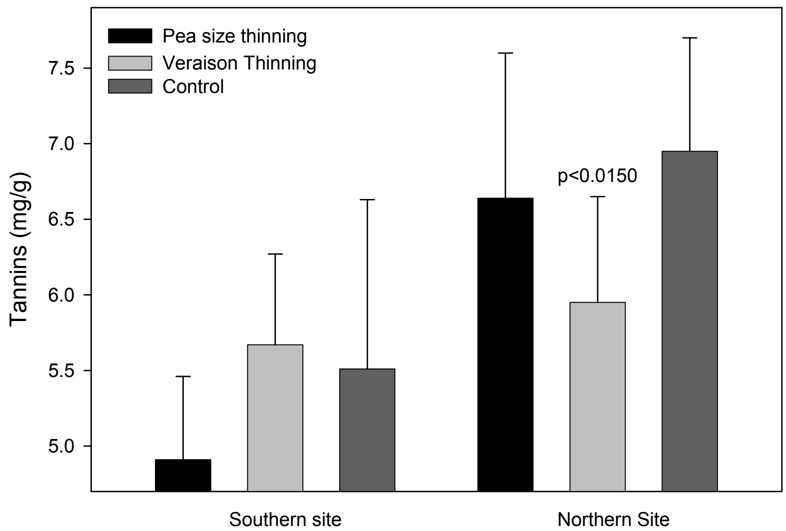

Figure 8. Tannin levels of grapes at harvest.

Other authors also note thinning to have no positive influence on fruit quality, regardless of timing of thinning (Keller *et al.* 2005, also reviewed in Jackson and Lombard 1993).

Results of wine sensory analyses did not indicate any significant differences between treatments, however wines produced from thinned treatments were ranked slightly lower on a 20-point scale (Tables 2 and 3, Figure 9).

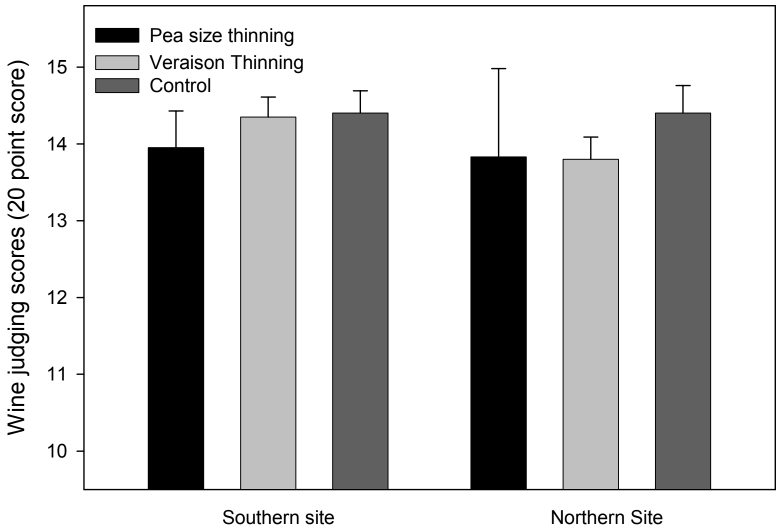

Figure 9. Judging scores for wines produced from the various treatments.

Outcomes and Conclusions

It can be concluded that under the seasonal conditions of this study, reducing yield by thinning did not result in an increase in fruit quality and that crop thinning at pea size may adversely influence quality of Merlot. Other authors have shown seasonal influences to override the effects of crop thinning (Keller *et al.* 2005), a factor believed to also impact on this study. Thinning also resulted in vines no longer having optimal LA/Y thus the findings may reflect vines being under cropped.

Benefits of this project, as anticipated in the application include the following.

Economic

- provision of advice leading to maximisation of grape and wine quality thus increased wine economic value *(the results question whether there is any real benefit from crop thinning of Merlot, thus growers and winemakers may benefit from advice to maintain higher crop levels, leading to production and sales of more wine of similar quality)*
- determination of whether the current practice of thinning which leads to reduction in fruit yield (therefore wine volume produced) truly provides economic benefit by way of a marked improvement in grape and wine quality *(the findings of this study indicate that crop thinning of Merlot may not provide any economic benefit, but actually an economic detriment, given fruit is discarded without any real increase in wine quality)*
- if proven to be of economic benefit, crop thinning resulting in reduced ripening time will reduce the risk of inclement late season weather negatively impacting on fruit quality *(under the seasonal conditions of this study, no benefit is indicated)*
- the path to adoption of findings is assured through involvement of industry in carrying out the research on commercial vineyards and investigating local practices *(the findings are considered by staff of the vineyards in which the trials were carried out, and have been discussed with local industry at meetings, seminars and workshops)*

Social

- pioneering research for Queensland wine industry will result in increased grape and wine research capability and recognition for the state *(the work has stimulated further* *local interest and understanding of the benefits of research; the state profile is being raised through presentation at national and international conferences, and publications to be submitted to national and international journals.*

- specification of this initial project has already brought together and initiated collaboration between key research, extension and education providers (USQ & DPI&F along with the Queensland College of Wine Tourism), the State Government, regional wine industry associations and commercial vineyards and wineries
- the work will enhance collaboration between these organisations, strengthening relationships to provide cooperative and strategic regional leadership and promoting activities of future benefit to the Queensland wine industry *(closer working and collaborative arrangements have resulted from this initial project)*
- publication of findings will enhance recognition of and promotion of the Queensland wine industry *(as noted above, presentations have been made at national and international conferences, and publications are in preparation)*

Recommendations

This study indicates that the common practice of crop thinning may not enhance fruit quality; in fact it may even be detrimental. Under the seasonal conditions of this study, no increase in fruit or wine quality was found for Merlot, leading to the conclusion that it may be economically detrimental to crop thin, as wine production and sales volumes are decreased with no increase in quality (and therefore no price premium).

It is anticipated that the experience with Merlot will be representative of other grape varieties; thus it is recommended that growers should be cautious only to thin if crop loads are exceptionally high.

Appendix 1: Communication

Preliminary and interim results from the study have been presented to the Queensland wine industry as follows:

1. Playsted, C., Kennedy, U., Hassall, T. &. Learmonth, R. P. Preliminary findings were presented at the DPI&F Viticulture Seminar: Winter 2007 Stanthorpe QLD 13th June 2007
2. Kennedy, U., Learmonth, R. P., Hassall, T. & Playsted, C. (2008) "Crop thinning of Merlot – a Queensland perspective". DPI&F Viticulture Seminar: Winter 2008, Stanthorpe QLD 18th June 2008.

Results have also been disseminated widely by presentation at conferences as follows:

3. Kennedy, U., Playsted, C., Hassall, T. & Learmonth, R. P. (2007) "Effects of bunch thinning in commercial Queensland vineyards on grape and wine quality" 13th Australian Wine Industry Technical Conference, Adelaide, 28 July – 2 August 2007.
4. Kennedy, U., Playsted, C., Hassall, T & Learmonth R.P. (2008) "Merlot in Queensland – seasonal influence on quality of grapes from crop thinned vines". 8th International Symposium on Grapevine and Plant Biotechnology, Adelaide, 23-28 November 2008.
5. Kennedy, U., Playsted, C., Hassall, T & Learmonth R.P. (2008) "Crop thinning of Merlot in Queensland - influence of timing of thinning on grape quality". 8th International Symposium on Grapevine and Plant Biotechnology, Adelaide, 23-28 November 2008.

Appendix 2: References

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