Wine Australia for Australian Wine

GOVERNMENT OF WESTERN AUSTRALIA

Department of Primary Industries and Regional Development

WINES OF WESTERN AUSTRALIA
Extraordinary Regions

Can post flowering harvester applications reduce bunch rot risk and manipulate bunch architecture in Western Australia?



FINAL REPORT FOR INCUBATOR PROJECT

Project number: **DPD 1901**

Principal Investigator: **Dr Andrew Taylor**

Project Supervisor: **Rohan Prince**

Research organisation: **DPIRD WA**

Date: 30 June 2020

Author details:
Dr Andrew Taylor, andrew.taylor@dpird.wa.gov.au

Disclaimer:
The Chief Executive Officer of the Department of Primary Industries and Regional Development and the State of Western Australia accept no liability whatsoever by reason of negligence or otherwise arising from the use or release of this information or any part of it.

Abstract

Experiments in New Zealand have shown promising results with the post flowering use of harvesters to reduce bunch rot incidence and manipulate bunch architecture. To assess whether these results can be achieved in Western Australia, harvester experiments were conducted on five white varieties across three different growing areas. No statistically significant findings, across a number of bunch compaction parameters and bunch rot incidence, were found for all harvester treatments. Weather conditions during the 2020 vintage in WA were optimal for grape growing, being the major influence behind these findings. Further investigations are required during years where less optimal weather conditions occur.

Executive summary

Bunch rots are a significant cost to the profitability of Western Australian wine producers due to direct losses of fruit, harvest downgrades and the costs associated with their control. Further pressure has occurred with the recent loss of iprodione from the market and export markets moving towards a requirement for fewer pesticide applications. Successful use of a post flowering harvester treatment would provide a pesticide free approach to bunch rot management.

Reducing bunch compaction is considered the holy grail of bunch rot management but this is not easy to achieve on mature vineyards. Use of harvesters to remove bunch trash after flowering has minimised bunch rots under New Zealand conditions and reduced compaction. It is unknown whether the same result will occur in WA due to differences in climatic conditions.

With the assistance of three commercial vineyards in the Margaret River and Pemberton regions this project is a preliminary investigation into the potential of post flowering applications of harvesters to reduce bunch rot in WA. Overall, the results did not highlight any significant differences in the harvester treatments and the non-harvester controls, as the weather during the 2020 vintage in south-west WA was not conducive for disease development. The fact that there was no differences recorded means there are no negative impacts on wine quality from the use of the harvesters at this growth stage. Further investigations are required during years where the weather is favourable for disease development, to provide a full understanding as to the impact of this control technique.

Aims and Background

There has been a rise in the number of WA vineyards trialling the use of harvesters pre-harvest in an attempt to remove bunch trash for bunch rot control. The experimentations are based on findings from overseas studies, primarily New Zealand, where they have found a “light” harvester treatment, post flowering, reduced botrytis (*B. cinerea*) incidence without affecting yield. However, as climate conditions and variety are important in the development of bunch rots, botrytis and sour rot, it is difficult to extrapolate the results seen overseas to those expected within WA. An example of this is the differences seen in the length of the flowering period between different growing regions and its impact on flowering treatment applications. Whilst recent trialling has occurred in WA, little quantifiable data has been recorded on the harvester technique and its effect on not only bunch rots but bunch architecture.

This project aims to develop quantifiable data determining: a) whether pre-harvest harvester application reduces the incidence of bunch rots under WA conditions b) whether the

application impacts bunch architecture or compaction and if so c) the optimal timing and harvester set up parameters.

Materials and Methods

Project Design

Three vineyards within the Margaret River, Pemberton and Karridale growing areas were selected as part of the trial. Each vineyard had blocks of white varieties that had experienced botrytis bunch rot in the previous season and the managers identified they were planning on using harvesters for trash removal during the 2019/20 season. Semillon and Sauvignon Blanc were selected at the Margaret River site, Sauvignon Blanc and Chardonnay at the Pemberton site and Semillon at the Karridale site. Originally, it was planned to have a site in the Swan Valley region but the property identified went through a sales process during this trial.

The harvester treatments were arranged in a randomised block design with two blocks per variety. Treatments consisted of three different harvester beater speeds and a non-harvester control (Table 1). A New Zealand standard beater speed (light at 480 BPM) was used across all three vineyards for comparison, whereas other treatment speeds were determined based on harvester operator experience. Each treatment was conducted on an entire row except at the Pemberton site where half rows were used. Average total row length at this site was over 300m. Measurements were taken from the fourth panel from the ends of each row.

Table 1: Harvester brand, model and set up for each site.

Location	Site 1 Margaret River				Site 2 Karridale				Site 3 Pemberton			
Harvester brand (model)	Gregoire G65				Gregoire G108				Nairn S80LS			
Treatment #	1	2	3	4	1	2	3	4	1	2	3	4
E-L stage of harvester treatment	29	29	29	29	29	29	29	29	29	29	29	29
Cordon height (mm)	1000	1000	1000	1000	700	700	700	700	1000	1000	1000	1000
Trunk rod (mm above ground)	n/a	600	600	600	n/a	570	570	570	n/a	800	800	800
Bottom rod (mm above ground)	n/a	1350	1350	1350	n/a	1400	1400	1400	n/a	1300	1300	1300
Middle rod (mm above ground)	n/a	1450	1450	1450	n/a	1500	1500	1500	n/a	1450	1450	1450
Top rod (mm above ground)	n/a	1500	1500	1500	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Beater speed (beats/minute)	n/a	420	480	520	n/a	420	480	520	n/a	270	330	300
Ground speed (km/hr)	n/a	5.6	5.6	5.6	n/a	5.8	5.8	5.8	n/a	4	5.5	4
Pinch (mm)	n/a	50	50	50	n/a	50	50	50	n/a	50	50	50

Measurements

Post harvester treatment

A week after the harvester treatments were applied ten bunches (five from each side of the row) were carefully removed from the fourth panel from the ends of each row. In the laboratory, bunches were weighed and shaken to remove the trash. To shake, individual bunches were placed in a 1.5L plastic soft drink bottle with the bottom end cut off and placed on bench top vortex mixer for 30 seconds. The trash would fall to the cap end of the bottle. After shaking, any further trash was removed by quickly brushing the bunch with a stiff bristled brush. The trash for the 10 replicate bunches was combined, weighed and placed

into plastic containers lined with moistened paper. The plastic containers were left on the laboratory bench under diffuse light, with air conditioning set at 20°C, for 14 days to determine if botrytis was present.

Botrytis Monitoring

Weekly assessments for botrytis were made after berry softening had begun (E-L 34) by observing 200 bunches (100 each side of row) in the treatment area. Bunches were assessed for botrytis incidence and severity using the assessment key as outlined in Hill et al. (2010).

Harvest

As close as possible to commercial harvest fifteen bunches were harvested from the fourth panel from the ends of each of the treatment and replicate (30 bunches per row total). In the laboratory, each bunch was weighed, measured for length and width (total bunch and rachis). Berries were removed, counted and weighed.

Bunch compaction was calculated using a number of indices as previously reported in Tello and Ibáñez (2014) and Wang et al. (2019). These include the following:

$$Bunch\ Volume = \frac{1}{3}\pi \times \left(\frac{width}{2}\right)^2 \times length$$

Bunch compactness:

$$BC1 = \frac{total\ no.of\ berries\ per\ bunch}{main\ rachis\ length}$$

$$BC2 = \frac{total\ no.of\ berries\ per\ bunch}{bunch\ volume}$$

$$CI - 12 = \frac{Bunch\ weight}{(Bunch\ length)^2}$$

The CI-12 index is one of the easiest measures of objective and quantitative bunch compaction as it only requires two bunch features but provides a high correlation with visual descriptors (Tello and Ibáñez, 2018).

Juice parameters

Berries from each of the 15 bunches per replicate were combined and pressed to allow for testing of juice parameters. Juice pH, Baume (°Be) and titratable acidity (TA), to end point pH 8.2 using 0.1M sodium hydroxide solution, were measured for each sample. pH and TA were measured using a PHM210 standard pH Meter (MeterLab) with °Be measured using a DMA 35N density meter (Anton Paar).

Data analysis

Data from all replicates was averaged and any statistical difference between treatments assessed using analysis of variance (ANOVA) at $p \leq 0.05$ significance level. ANOVA's were performed in Genstat 19th edition (VSN International Ltd.).

Results and Discussion

Harvester observations

Each of the different harvesters were successful in removing shoots and leaves from the treatment rows (Figure 1a and b). Upon closer inspection there was evidence of immature berries being knocked off as part of the process and collected in the bottom of the harvester trays (Figure 2). These photos were taken at the completion of entire rows and therefore represent shaking of a large number of individual vines. It was expected that the faster the beater speed the more shoot and leaf removal but it appeared that at the higher speed an oscillation frequency develops within the row where less leaf and shoot material is removed. Originally, we had collected trash material from under the harvesters per plot but as standardised measurements for trash collection have not been established and the differences in harvester height meant container sizes would differ we abandoned this idea. The beater speed and rod placement for optimum trash removal and or bunch architecture for specific harvester models under WA conditions requires further investigations.



Figure 1: Trash collected in a Gregoire (a) and Nairn (b) after an entire treatment row.



Figure 2: Immature berries collected in the base of the harvester.

An unexpected observation from the harvester treatments was that regardless of beater speed the technique was rather successful in knocking snails from the canopy. The use of

harvesters in this way may have future applications as a snail management technique by dropping snails prior to management actions taking place.

Trash assessment

The incidence of incubated containers where botrytis developed on pieces of trash ranged from 44 to 87.5% across the different sites, indicating the potential for latent infection of *B. cinerea* (Figure 3). Flowering time is known to be high risk for *B. cinerea* infection and carryover from previous seasons can be important for inoculum load (Nair et al., 1995).



Figure 3: *B. cinerea* growing from bunch trash after incubating in humid container.

Botrytis monitoring

After weekly inspections at the Margaret River site from veraison to harvest there was no incidence of botrytis recorded. At the Karridale and Pemberton sites, incidence from the 200 observed bunches were at, or less than, 1% within all treatments. Of the infected berries severity was approximately 15%. As a result of the low botrytis incidence no statistical analysis was conducted on the data.

Harvest and Juice parameters

Despite visually observing immature berries and some variation between treatments there was no significant difference between any of the bunch parameters for any cultivar, across any of the sites (Table 2,3,4). These parameters include bunch weight; post treatment and at harvest, trash weight, bunch volume and any of the compaction indices. A combination of harvester set up and the weather during the 2020 vintage was the reason behind this result. While changes in beater speed occurred as part of the treatments, each harvester was set up for a reduction in trash rather than that of bunch thinning. Bunch thinning, in this instance, is not removal of bunches but removal of berries within bunches. This means the rods above the fruit zone were higher than required to mechanically thin bunches to produce a significantly different result, in comparison to the control. Research on bunch thinning in New Zealand highlights the closer the rods are placed to the fruit zone the more berries are removed (New Zealand Winegrowers 2014).

The 2019/20 season saw warm and dry conditions at flowering across south-west growing regions that meant flowering was rapid, harvest was early and disease pressure was low. The weather experienced during the 2020 vintage has industry representatives predicting it to be one of the best on record for wine quality (Costley, 2020). Warm dry conditions at flowering result in rapid cap fall which reduces the chances of stuck caps and subsequently less bunch trash and risk of disease at harvest. The weather remained warm and dry throughout the season and therefore risk of botrytis infection at harvest was low, allowing winemakers to leave fruit on vines with a focus on juice quality over disease risk.

Table 2: Parameters measured after harvester treatments, at harvest and for juice at the Margaret River site.

	Sauvignon Blanc				Semillon			
Treatments	1	2	3	4	1	2	3	4
Post treatment								
Bunch weight (g)	17.16	15.56	16.04	15.46	36.8	35	33.1	32.5
Trash weight (g)	5.067	4.692	4.535	4.818	3.308	3.433	3.131	2.911
At harvest								
Bunch length (cm)	11.56	11.89	11.51	11.61	13.48	13.57	13.67	13.47
Bunch width (cm)	6.48	6.45	6.41	6.33	9.07	9.3	10.29	9.42
Bunch weight (g)	137.96	129.77	127.88	130.15	246.64	263.77	271.36	256.1
Berries per bunch	96.22	91.95	90.42	91	98.97	99.17	107.67	104.52
Berry weight (g)	1.32	1.27	1.27	1.33	2.47	2.61	2.54	2.39
Bunch volume (cm^3)	132.54	133.55	131.93	128.02	303.21	340.76	494.61	331.55
BC1	7.99	8.17	8.38	8.28	7.27	7.26	7.65	7.81
BC2	0.76	0.79	0.82	0.83	0.37	0.45	0.32	0.35
CI-12	0.98	0.93	0.95	0.98	1.37	1.52	1.44	1.54
Juice characteristics								
Juice pH	3.27	3.22	3.24	3.21	3.18	3.18	3.19	3.19
Juice Baume (°Be)	12.57	12.12	12.2	11.97	11.56	11.52	11.4	11.72
Juice TA	6.79	6.71	6.46	7.05	7.56	7.72	7.18	7.25

There was no significant difference between any of the four treatments for any of the parameters measured for Sauvignon Blanc and Semillon.

Table 3: Parameters measured after harvester treatments, at harvest and for juice at the Karridale site.

	Semillon			
Treatments	1	2	3	4
Post treatment				
Bunch weight (g)	35.3	38.4	33.2	34.7
Trash weight (g)	3.099	3.07	3.007	2.917
At harvest				
Bunch length (cm)	14.17	14.69	14.74	14.55
Bunch width (cm)	8.96	9.33	8.89	9.06
Bunch weight (g)	241.08	228.97	244.48	247.88
Berries per bunch	100.2	105.31	104.47	106.92
Berry weight (g)	2.38	2.12	2.26	2.29
Bunch volume (cm^3)	389.37	286.66	340.19	334.62
BC1	7.41	7.68	7.16	7.25
BC2	0.33	0.41	0.34	0.74
CI-12	1.24	1.3	1.17	1.14
Juice characteristics				
Juice pH	3.04	3.06	3.035	3.022
Juice Baume (°Be)	10.02	10.3	10.5	9.68
Juice TA	8.77	8.6	8.42	8.41

There was no significant difference between any of the four treatments for any of the parameters measured for Semillon.

Table 4: Parameters measured after harvester treatments, at harvest and for juice at the Pemberton site.

	Sauvignon Blanc				Chardonnay			
Treatments	1	2	3	4	1	2	3	4
Post treatment								
Bunch weight (g)	15.25	14.95	17.48	18.09	12.84	14.49	13.79	13.58
Trash weight (g)	5.62	2.88	3.56	4.91	6.5	4.84	4.04	5.32
At harvest								
Bunch length (cm)	11.43	10.87	11.34	11.07	10.83	10.54	10.32	9.91
Bunch width (cm)	6.23	6.03	6.18	6.37	7.1	6.89	6.84	6.48
Bunch weight (g)	143.74	133.65	139.01	132.83	100.39	107.81	82.67	77.53
Berries per bunch	87.07	86.58	84.39	78.32	159.59	132.74	158.7	141.52
Berry weight (g)	1.58	1.47	1.57	1.63	0.67	0.84	0.55	0.58
Bunch volume (cm^3)	121.16	110.55	118.64	123.88	154.17	139.81	131.05	117.67
BC1	7.58	7.91	7.52	6.98	14.82	12.64	15.39	14.21
BC2	0.78	0.9	0.84	0.69	1.23	1.11	1.31	1.52
CI-12	1.09	1.13	1.11	1.09	0.87	0.97	0.79	0.81
Juice characteristics								
Juice pH	3.09	3.145	3.072	3.1	3.16	3.14	3.12	3.15
Juice Baume (°Be)	11.55	11.82	11.1	11.4	12.3	12.15	12.17	12.4
Juice TA	9.82	8.93	10.74	10.46	7.97	8.17	8.65	7.85

There was no significant difference between any of the four treatments for any of the parameters measured for Sauvignon Blanc and Chardonnay.

Conclusion and Recommendation

This project should be considered preliminary research into the use of harvesters post flowering to reduce bunch rot risk and manipulate grape bunch architecture. The project has highlighted the influence weather conditions have on disease incidence and severity, with the 2020 vintage being described as one of the best in terms of growing season weather the south-west grape growing regions have seen in a number of years. Despite the weather not being favourable for disease development, the fact that botrytis could be induced from the trash and debris in the incubation chambers indicates that had the weather been less favourable, botrytis expression was likely. It is therefore recommended that projects of this type be run over multiple seasons to take into account the large influence weather plays, not only on botrytis development but on grapevine phenology.

Whilst this project was based on work conducted in New Zealand over a number of years, I was unprepared for the variables that needed to be considered when it came to harvester brands and set ups. For instance, the Nairn harvester used in this project appeared to be operating at a much lower beater speed than the Gregoire harvesters. This was a surprise to the operator and from anecdotal reports potentially may occur from an extra cog added to the harvester, resulting in differential readings to other harvesters. This highlights that even if generalised recommendations for the use of harvester treatments are made, each vineyard operator will be required to test sections of rows for optimal harvester speed and beater speed prior to implementing across the whole vineyard.

Another variable encountered during the project was there is no official standardised measure for the effectiveness of trash removal. As the different harvesters operate at different heights the use of containers under vines meant repetition between different vineyards and varieties is problematic. The use of drop sheets and tarpaulins also have issues due to how vines are managed between vineyards. For example, the number of vines per panel and the number of bunches per vine differ, meaning comparisons using panels can be difficult. A standardised measure of trash removal will be required for future experiments in this area.

The results of this project indicate that vineyard managers need to decide whether the aim of harvester use is to solely remove trash from the bunch or whether they are aiming at bunch thinning. Bunch thinning to remove berries from bunches requires the top rods to be closer to the fruit zone and operating at a different speed to a set up that would occur solely to remove trash.

On face value the results of this project suggest that the use of harvesters post flowering to reduce bunch rots and manipulate bunch architecture is not necessary in WA. However, the fact that there was no negative impact on juice quality indicates there is no detrimental effect in their use. Is the use of a harvester post flowering economically justifiable? If the vineyard owns its harvester then this is a technique that increases the use of its asset and does not negatively impact on potential wine quality. The use of harvesters for bunch rot minimisation and bunch architecture manipulation during a bad bunch rot season would be required before a definitive answer can be made on its economic feasibility.

As this work is a preliminary investigation in the use of harvesters on bunch rot management in WA further research is required to:

- Develop a standardised measure of trash removal that can be incorporated across WA vineyards.

- Optimise the height of the top rods to manipulate bunch compaction indices rather than trash removal.
- Optimise timing of harvester application. Can treatments be conducted at a more advanced growth stage without impacting on grape and wine quality?

Extension

The extension component of the project was impacted by the COVID 19 outbreak that resulted in restrictions on travel and social distancing a couple of weeks after the last harvest occurred. Despite the restrictions extension of the project has and will occur via:

1) Growers participating in the project have had direct communication of the results.
2) Wine Industry Newsletter (WIN) article summarising the results (March 2020).
3) WA wine industry technical committee will be presented with the results and final report lodged.
4) As part of the WA regional program a consultant from NZ has been identified to present on how they set up the harvesters for bunch thinning. At this demonstration I can present the results of the incubator project. COVID travel restrictions have meant a specific timing for this to occur is currently not known.

Researcher benefit and feedback

The regional incubator program has increased my knowledge of the mechanical and technological aspect of wine grape viticulture in Australia. Prior to my involvement in this project I knew little about the operation and use of mechanical harvesters and it has been a steep learning curve in that regard. With an industry drive towards more cultural management techniques for disease control this project has benefitted me in understanding the challenges and benefits this brings. The project has also helped in fostering stronger relationships and networks, both within the WA wine community and with national and international plant pathologists working on botrytis bunch rot.

An improvement for the incubator initiative would be to extend the projects so that if required they be multi-seasonal. The results of this project highlight the influence of weather on the development of bunch rots. However, had the project also been run during the 2019 vintage, where weather conditions were favourable for botrytis, a comparison could be made between seasons.

References

Costly, D. 2020. Margaret River winemakers tip 2020 as best yet. *Decanter*. 4-2-2020. Available at: https://www.decanter.com/wine-news/margaret-river-winemakers-tip-2020-as-best-ever-431458/. Accessed: 10-5-2020.

Hill, G. N., Beresford, R. M. & Evans, K. J. 2010. Tools for accurate assessment of botrytis bunch rot (*Botrytis cinerea*) on wine grapes. *New Zealand Plant Protection,* 63: 174-181.

Nair, N., Guilbaud-Oulton, S., Barchia, I. & Emmett, R. 1995. Significance of carry over inoculum, flower infection and latency on the incidence of *Botrytis cinerea* in berries of grapevines at harvest in New South Wales. *Australian Journal of Experimental Agriculture,* 35: 1177-1180.

New Zealand Winegrowers. 2014. Mechanical Thinning: Why, What, When and How. New Zealand Winegrowers Fact Sheet. 1-6

Tello, J. & Ibáñez, J. 2014. Evaluation of indexes for the quantitative and objective estimation of grapevine bunch compactness. *Vitis,* 53(1): 9-16. Tello, J. & Ibáñez, J. 2018. What do we know about grapevine bunch compactness? A state-of-the-art review. *Australian Journal of Grape and Wine Research,* 24: 6-23.

Wang, X., De Bei, R., Fuentes, S. & Collins, C. 2019. Influence of canopy management practices on canopy architecture and reproductive performance of Semillon and Shiraz grapevines in a hot climate. *American Journal of Enology and Viticulture,* 70(4): 360-372.