Developing downy mildew management strategies for Western Australian wine regions.



FINAL REPORT to

GRAPE AND WINE RESEARCH & DEVELOPMENT CORPORATION

Project Number: **RT 08/03-4**

Principal Investigator: **Andrew Taylor**

Research Organisation: **Wine Industry Association, Western Australia**

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Executive summary

This study was aimed at determining the current understanding of downy mildew of grapevines in WA vineyards. Downy mildew first appeared in WA ten years ago and is now established in the majority of growing regions with management being required by growers to prevent severe yield loss. Localised outbreaks of the disease are quite common in WA but the 2008/09 saw significant infection events occur across many of the growing regions.

Peter Magarey, Magarey Plant Pathology South Australia, visited WA and presented current information to groups in the Margaret River and Frankland River regions during 2009. These regions were selected as Margaret River has experienced downy mildew at a localised level for several seasons whereas 2008/09 was the first record of downy mildew in Frankland River. Peter presented information regarding lifecycle, symptoms and signs of disease, pre infection and post infection management and other control options.

At each of these workshops a questionnaire was handed to participants to gauge current grower understanding on downy mildew. Sixty-two growers from both workshops answered questions regarding spray programs, disease severity, disease monitoring, management techniques and weather monitoring. Results from the questionnaire revealed the majority of growers in WA manage downy mildew through a preventative spray program and that this program is successful in most years in controlling downy mildew. As expected differences were found between the two regions in the study in terms of bag testing for downy mildew and alternate plans when post infection spray options are exhausted.

Growers were asked to monitor their management techniques for downy mildew the following 2009/10 season to determine whether changes were made as a result of the Peter Magarey visit. The season was particularly hot and dry and therefore downy mildew was not present in any grape growing region of WA. Peter Magarey returned in September 2010 to present further seminars in the Swan Valley, Bunbury and Margaret River with emphasis on powdery mildew. Peter presented information regarding the lifecycle, climatic conditions that favour disease development, symptoms and signs of disease and control options.

Further industry consultation is required to determine the feasibility of setting up a weather based decision tool to combat downy mildew in WA. Although some growers indicated they would prefer a system to be implemented many decisions on how the system would run, who would maintain and run the system and who and how growers would pay for it still remain undecided and require resolution.

At present most regions control downy mildew through preventative spray programs generally involving copper based products with 4-5 sprays per season. In years where climatic conditions are conducive to downy mildew this program may not provide adequate control and it is hoped that the workshops provided during this study provide growers with enough information to prevent significant loss in the future.

Background

It has been 10 years since downy mildew of grapes first appeared in Western Australian vineyards. Since the initial detection the disease has now been recorded in the majority of growing regions and its control has become an important addition to management decisions and spray regimes. From time to time small localised outbreaks have occurred on individual vineyards where preventative sprays have been missed and or have been unsuccessful. This is in contrast to a previous GWRDC study, RT 01/06 (Lantzke 2004), that found the Margaret River region of WA was highly likely to experience severe downy mildew outbreaks 4 out of every 5 years based on previous weather data.

However, the 2008/09 growing season in the south-west of WA was one of the most severe for downy mildew seen in the state since its first detection in 1998. Major grape growing areas of Margaret River, Pemberton, Manjimup, Frankland River and the Great Southern all experienced weather conditions that were highly conducive to downy mildew infection. Large rain events occurred during September, October and November of 2008 that lead to extended flowering periods and resulted in a severe outbreak of the disease on foliage and bunches that caused significant concern to growers in these regions.

Downy mildew is a highly weather dependant disease and as a result models can be written to predict both primary and secondary infection events. Using certain weather parameters such as 10mm of rainfall or irrigation, ≥10°C over 24 hours (10:10:24) and 98% humidity, 13°C, ≥4 hours of darkness and 2-3 hours leaf wetness (98:13:4) algorithms can be written to accurately predict when infection events occur. At present it is uncertain as to whether growers in WA would require a prediction based model or in fact want a similar service to be developed and delivered.

This outbreak highlighted several issues amongst WA growers including; the understanding of the chemical control options available for downy mildew, in particular post infection control; decision support based systems to enable growers to make more informed decisions about when to spray and what with for downy mildew; and identified knowledge gaps for growers who have not previously experienced downy mildew outbreaks and information about the epidemiology of the disease.

Project aims and performance targets

This study was conducted to determine how far the Western Australian viticulture industry has progressed in its understanding and management of grapevine downy mildew ten years since the first occurrence in the state. Information will be sought on current management techniques and knowledge gaps whilst new information will be disseminated to growers. Information will be extended to new growers in regards to techniques currently not in use by them as they have never experienced a severe downy mildew outbreak.

The initial project submission included a focus on developing a web based decision support tool for the management of downy mildew by wine grape producers in Western Australia. In consultation with GWRDC this focus was changed to one of gathering the opinions of growers on the need and viability of a webpage decision support system based on data from weather stations located in the growing regions of Western Australia.

Outputs	Performance Targets	Target Date
Education, extension and workshop material developed and produced	Develop and collate information material on strategies for management on downy mildew in WA wine regions	July 2009
Regional workshops on Downy and Powdery Mildew in Margaret River and Frankland	Present information on downy and powdery mildew and evaluate grower interest in developing of a webpage decision support system based on data from weather stations located in the growing regions of Western Australia	August 2009
Regional profiles on management downy and powdery mildew		October 2009
Seasonal Review Workshops	Presented latest information on management of downy and powdery mildew and review management strategies in Western Australian wine regions with participants.	September 2010
Final Report		September 2010

Methods

A series of regional workshops presented information to growers on both downy and powdery mildew to growers in Margaret River and Frankland River grape growing regions of Western Australia. These regions represented different experiences with downy mildew infection; Margaret River having experienced localized infections since the late 1990's, while the 2008/09 season was the first time the Frankland River region experienced a downy mildew outbreak. At the workshops Peter Magarey, Magarey Plant Pathology South Australia, delivered information on the symptoms, signs, epidemiology and control options for both downy and powdery mildew and interacted with growers to determine their primary motivators from spraying and the control strategies employed.

Pre-season workshops were held in August 2009 and post season review workshops in September 2010.

During the pre-season workshops, a questionnaire was given to participants to gather information on their current understanding on downy mildew including monitoring techniques, management, control options and losses caused by downy mildew in their vineyards. After the workshop had been completed a follow up questionnaire was given to attendees to answer questions relating to what they had learnt from the workshop and whether there was any benefit in setting up a weather based prediction service in Western Australia.

Peter returned to WA in 2010 to take part in more grower education in regards to downy and powdery mildew as a speaker at the Grape and Wine Updates: Spring Vine Health series undertaken by DAFWA, GWRDC, WIAWA, Curtin University, NWGIC and WAVIA. These seminars took place in the Swan Valley, Bunbury and Margaret River regions in September.

For new growers to the industry and those who may not have experienced any severe outbreaks of downy mildew, extension material including farmnotes and articles were designed to provide information in preparation for a possible future outbreak of downy mildew.

Results/Discussion:

All the workshops were well attended. A total of 62 growers attended the workshops at Margaret River (43) and Frankland (19), and 98 growers attended review workshops at Swan Valley (26), Bunbury (11) and Margaret River (61). Peter Magarey's presentations were well received and there was a great deal of interaction between attendees and the presenters (Figure 1).

Preseason workshops
At each workshop Peter Magarey presented information on downy mildew of grapes with the main emphasis on:

1. Symptoms and signs of downy mildew.
2. Downy mildew lifecycle including primary and secondary infection.
3. How the disease infects and moves inside the plant.
4. Best technique for spray application including pre infection and post infection sprays.
5. Length of time after infection when a post infection fungicide can be used.

These findings were reflected in the grower responses to the pre and post workshops questionnaires (Table 1). The 2008/09 season saw 65% of growers in Margaret River and 74% in Frankland River experience a downy mildew event (Table 1). Only 33% of growers in Margaret River felt that this season was the worst recorded however. Ninety five percent of Frankland River growers on the other hand felt that it was the worst season recorded. This indicates the difference between the two regions whereby Margaret River is a region that has experienced sporadic downy mildew infections over the past 10 years and has growers who have experience dealing with these outbreaks. The Frankland River region had not until the 08/09 season officially experienced a downy mildew outbreak and therefore the differences in questionnaire responses.

A total of 94% of growers from both regions regularly monitor for downy mildew in their vineyard with both regions having similar proportions of growers who monitor weekly, 70% and 79% for Margaret River and Frankland River respectively, and those who monitor twice weekly, 14% and 16% for Margaret River and Frankland River respectively. The difference between regions is seen with those growers who bag test, 74% of growers in Frankland River regularly bag test whereas only 58% of Margaret River growers do. This may indicate that growers in Margaret River are more experienced in distinguishing oil spots on grapevine leaves from other symptoms and therefore do not perform bag tests as frequently.

Respondents indicated that the vast majority (97%) based their spray programs on a pre infection regime whilst only 2% of growers used a post infection regime. This is not surprising given that there are a greater number of pre infection fungicides available in the market for growers to use than post infection sprays. Approximately 75% of growers indicated that they used copper based sprays as part of their pre infection spray regime with many indicating during the workshop that this is often mixed with sulphur sprays and sprayed every 10 to 14 days. Eighty six percent of growers from Margaret River and 84% of Frankland River growers felt that this combination of spray timing and type of chemical was effective in reducing damage caused by downy mildew.

Only 30% and 47% of growers from Margaret River and Frankland River respectively, felt that they had any back up spray options after they had exhausted the use of metalaxyl based fungicides. With the removal of phosphorous acid as a post infection control option it has meant the industry in WA is reliant on metalaxyl and other related registered phenylamide products for post infection control. Once post infection spray options are exhausted control must occur through other management techniques.

Of the growers attending the seminars 65% from Margaret River and 84% from the Frankland River region felt that a weather service was needed for better management of downy mildew outbreaks. Several options were raised at the seminar in terms of what would be involved in a weather service but only 53% of Margaret River and 42% of Frankland River growers indicated that they were willing to pay for any service. More industry consultation will be required to determine whether it is feasible to have a weather service with this amount of growers offering financial support.

Post season workshops

The 2009/10 season was a particularly dry and hot season in the southwest of WA and there were no recordings of any downy mildew present in vineyards. The high temperature caused some crop loss due to sunburn whilst later in the season powdery mildew became apparent in several regions. Despite the lack of downy mildew seen during the season growers did not make any changes to their spray regime from the previous two seasons indicating that calendar spraying, generally with copper based compounds, was the most common practice.

Peter Magarey conducted a post 2009/10 season review at the Grape and Wine Update and Spring Vine health seminars. Given the lack of downy mildew present during the season Peter's review was dominated by discussions about the more prevalent powdery mildew. The review topics included discussions about:

1. Life cycle of powdery mildew including flag shoots and cleistothecia
2. Powdery mildew only infects green tissue.
3. Symptoms and signs of powdery mildew on leaves, bunches and berries.
4. Managing powdery mildew is a 2 year assignment
5. When and how long should I begin spraying for powdery including post harvest.
6. Are there any post infection sprays for powdery mildew?

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Extension Material

Extension material in the form of farmnotes were published on the bag test technique used to determine whether active downy mildew oilspots are present in the vineyard; and information regarding the active ingredients and mode of action of several of the most commonly used chemicals against downy mildew.

Table 1: The number and percentage of respondents for pre and post workshop questions from both the Margaret River and Frankland River seminars.

	Margaret River		Frankland		Total
	No.	%	No.	%	%
PRE WORKSHOP QUESTIONS					
Experienced DM in 08/09 season	28	65	14	74	68
08/09 season worst recorded	14	33	18	95	52
Weather the primary cause of the problem	24	56	17	89	66
Did DM cause crop loss in 08/09 season?	3	7	1	5	6
Does DM usually cause crop loss?	2	5	0	0	3
Monitor weekly for DM	30	70	15	79	73
Monitor twice weekly for DM	6	14	3	16	15
Total monitoring	40	93	18	95	94
Bag test for DM	25	58	14	74	63
Spray program pre infection based	41	95	19	100	97
Spray program post infection based	1	2	0	0	2
Any back up for metalaxyl use?	13	30	9	47	35
Copper based spray program	32	74	13	68	73
Spray program successful	37	86	16	84	85
Weather station located on your property	12	28	1	5	21
Do you keep records of weather activity?	30	70	16	84	74
Are cultural management techniques employed?	13	30	8	42	34
POST WORKSHOP QUESTIONS					
Did you learn anything from the workshop?	43	100	16	84	95
Will you change your management technique due to the workshop?	14	33	10	53	39
Is there more about chemicals for downy mildew you wish to learn about?	13	30	4	21	27
Is there more about cultural management you wish to learn about?	14	33	4	21	29
DM weather service needed	28	65	16	84	71
DM weather service not specific enough	11	26	0	0	18
Is a weather service the best way to go for disease incidence and severity in the WA wine industry?	31	72	15	79	74
Would DAFWA run the service?	12	28	3	16	24
Would WIAWA run the service?	12	28	3	16	24
Are you willing to provide data for the service?	23	53	12	63	56
Are you willing to pay for a weather service?	23	53	8	42	50
Number of respondents	43		19		62

Regional Profiles

Margaret River

Downy mildew was first identified in Margaret River during the 1999/2000 season, one growing season after the first confirmed identification in WA. Based on analysis of previous weather data it was predicted that downy mildew would be present in Margaret River four out of every five years (Lantzke 2004). This was based on being in close proximity to the coast and therefore likely to receive rain events during the spring and summer months that lead to enough leaf wetness for primary and secondary infection events to occur.

This has not been the case however; most growers in the region have seen the disease only a couple of times in the 9 years since its first detection with some growers never having an outbreak. Growers in Margaret River have generally been involved in the viticulture industry for several years with the majority having over 10 years experience with a large proportion of these having greater than 20 years experience. Experienced growers may explain part of the reason as to why downy mildew has not appeared as frequently as predicted from previous weather data with growers able to identify and control outbreaks efficiently before becoming a problem. This is combined with the drier spring and summer weather conditions experienced since the data was analysed.

Given most growers in Margaret River base their spray schedule on a pre infection program (Table 1) the motivators behind the decision to spray includes the current weather and to be safe in case the weather becomes conducive to disease development. As a result most growers in the region spray 4 or more sprays per season as an insurance policy against downy mildew infection regardless of whether the climate is conducive to downy mildew infection.

With Margaret River covering approximately 100km from North to South and 27km East to West (Margaret River Wine 2005) there still remains a risk that a severe downy mildew event will occur across some or the entire region. Despite these severe seasons not occurring as frequently as predicted if growers are not applying their pre infection sprays correctly then infection is likely to occur. This is shown when localized infections occur on vineyards where preventative sprays are unsuccessful or are missed. With the majority of growers using a pre infection program if weather conditions prevent spraying for sustained periods this will cause added pressure on post infection sprays in the region.

Frankland River

Frankland River is an inland growing region and therefore does not receive the extent of spring and summer rainfall that Margaret River can experience. As a result the 2008/09 season was the first time Frankland River had recorded a downy mildew outbreak where extensive spring/summer rainfall did occur. Growers in the region have similar experience in viticulture to that of Margaret River with most having been in the industry for approximately 15 years. Given the rarity of downy mildew events in this region however the growers have less experience with downy mildew than other regions of WA.

Like Margaret River the majority of growers in Frankland River manage downy mildew through pre infection sprays (Table 1) and they are motivated to spray as an insurance measure just in case a downy infection event could occur. On average 4 to 5 preventative sprays are used per season to prevent downy mildew from establishing in the vineyard. The risk Frankland River growers face is that due to the irregularity of downy mildew in the region they may become complacent with the timing and technique of their pre infection sprays so when seasons like 2008/09 occur they may not be fully protected and there may be difficulties if post infection sprays are not easily available.







Figure 1: Peter Magarey presentations on downy and powdery mildew at Frankland River 2009 (A), Margaret River 2009 (B) and Margaret River 2010 (C).

Outcomes/Conclusions

A total of 5 workshops were presented to grape growers in major growing regions of WA across two seasons. Growers were presented information on both downy and powdery mildew and showed increased knowledge on symptoms and signs of disease, epidemiology and management techniques. Information regarding spray technique and timing was presented to growers to better prepare them for seasons such as 2008/09. With more efficient spray timing and technique growers will be more assured their pre infection spray program is sufficiently controlling their vines. The results of this will be an industry that will be better prepared for seasons where a severe outbreak of downy mildew occurs.

Downy mildew appears to be a sporadic and localized disease in WA and only cause's widespread infection in years where wet springs occur such as was the case in 2008/09. Despite the high level of infection during that season growers in WA still feel confident that their spray programs based on preventative spraying, on average 4-5 times per season, is preventing downy mildew from causing any yield and economic loss. This study has helped growers to better understand the role climate plays in the life cycle of downy mildew and therefore should help growers to prevent further localized outbreaks of the disease through improved management and better spray coverage.

A weather service that predicts the likelihood of downy primary and secondary infection events was discussed in the workshops during 2009 and the majority of growers present believed that this would be good for industry progression. However, further work is required to determine how this service would be implemented across the vast growing regions, who would run the service and a decision by industry is needed on who would manage and pay for the service. Grower's opinions on the need for and how the service could be achieved differ greatly and more consultation is required.

Powdery mildew is a constant presence in WA vineyards and the biggest cause of economic loss in the industry. This is despite the substantial research into the fungus and its management. Through educating growers on the life cycle of powdery mildew and the understanding that it takes at least two growing seasons before significant control is achieved it is aimed that future loss is reduced. Spray technique, timing and the right fungicide are keys to controlling powdery mildew in WA vineyards.

Extension articles have been produced and published in the Australian and New Zealand Grapegrower and Winemaker and in the Wine industry Newsletter.

Recommendations

It is recommended that the wine industry of WA gives further consideration to the design and implementation of a weather based service for downy mildew in WA. It is suggested that a collective group of growers should drive the process. In the absence of a weather based predictive system for downy mildew infection the industry will continue to manage the disease based on individual weather stations and preventative programs.

With only a small percentage of growers indicating that they have a plan if the use of metalaxyl or related products is exhausted it is recommended growers set out an action plan for the management of downy mildew post infection. This could include cultural control plans or the maintenance of preventative sprays for parts of the vines that are not infected.

Given the sporadic nature of downy mildew outbreaks in regions such as Frankland River it is recommended that workshops similar to those carried out in this study are carried out every 5-10 years to educate new members of the viticulture industry or to refresh those who have previously attended. This will allow growers to maintain there knowledge and skills in case a severe outbreak was to occur.

Appendix 1. Communication

Presentation of whole of vineyard approach to management of Downy Mildew and develop strategies for local conditions in Western Australian wine regions.

Regional workshops 'Developing long term strategies for the control of Downy Mildew in Western Australian vineyards' held in Margaret River on 25th August and Frankland River on 27th August 2009 (see Workshop Flyer below).

(i) Peter Magarey presented information on the symptoms, signs, epidemiology and control options for both downy and powdery mildew. Interaction with growers to determine their primary motivators from spraying and the control strategies employed.

(ii) Participants completed questionnaires on their current understanding on downy mildew including monitoring techniques, management, control options and losses caused by downy mildew in their vineyards, and whether they saw any benefit in setting up a weather based prediction service in Western Australia.

Information material included:

- Downy Mildew is a wet-weather disease
- Powdery Mildew is a dry-weather disease
- Bag testing for downy mildew.

Results published to broader viticulture industry:

- Andrew Taylor (2009). A snapshot into downy mildew in WA: 10 years on. Australian & New Zealand Grapegrower & Winemaker. November 2009 – Issue 550
- Andrew Taylor and Trevor Wicks (2010) Activity of fungicides registered for controlling downy mildew in grapevines. Australian & New Zealand Grapegrower & Winemaker. May 2010 – Issue 556
- Farmnote (2009): How to bag test for downy mildew of grapes. Andrew Taylor, DAFWA.
- Andrew Taylor: Downy mildew management: a review of workshops. Win Industry Newsletter. No. 93 December 2009.
- Farmnote (2010): Activity of fungicides registered for controlling downy mildew in grapevines. Andrew Taylor, DAFWA and Trevor Wicks, SARDI.

Review of Downy Mildew management strategies in Western Australian wine regions

As part of 'Grape and Wine Updates and Spring Vine Health' seminars held in Swan Valley on 21 September, Bunbury on 22 September and Margaret River on 23 September 2010. These seminars provide latest information on Research and Development being conducted in WA for the grape and wine industry (see Seminar Flyer below).

Peter Magarey presented latest information on management of downy and powdery mildew and review management strategies in Western Australian wine regions with participants.

Information material included:

- GWRDC Factsheet 'Managing Downy Mildew (Winning the war!). Peter A. Magarey. March 2010
- GWRDC Technical Booklet 'Managing Downy Mildew (Winning the war!). Peter A. Magarey. March 2010
- GWRDC Factsheet 'Managing Powdery Mildew (Doing it better!). Peter A. Magarey. March 2010
- GWRDC Technical Booklet 'Managing Downy Mildew (Doing it better!). Peter A. Magarey. March 2010
- Video Clip 'Managing Downy Mildew (Winning the war!). Peter A. Magarey. March 2010.

Appendix 2. References

Lantzke N (2004) RT 01/06 *Downy mildew infection events in Western Australian viticultural regions*. Final report Grape and Wine Research and Development Corporation.

Margaret River Wine Industry Association (2005) About the region: A region commanding attention. Retrieved 12th December 2010, from http://www.margaretriverwine.org.au/aboutregion.php.

Appendix 3. Staff

Staff engaged on this project include:

- Andrew Taylor, Research Officer Viticulture, DAFWA Bunbury
- Diana Fisher, Development Officer Viticulture, DAFWA, Manjimup

Workshop contributions:

- Andrew Taylor, Research Officer Viticulture, DAFWA Bunbury
- Glynn Ward, Wine Project Manager, DAFWA, South Perth.

Appendix 4. Acknowledgements

We would like to thank Peter Magarey for taking the time to present the information regarding downy and powdery mildew to WA grape growers. Dr Trevor Wicks for providing input into chemical aspects of downy mildew control. Members of the DAFWA premium wine project are thanked for providing support throughout this project. Thanks to GWRDC for their investment into this project through their Regional Innovation and Technology Transfer program

Appendix 5. Budget reconciliation

Budget	Funding required from GWRDC		Actual Expenditure
Travel for field incl accommodation	600.00		1,500.00
Downy weather plan	2,000.00		0.00
Room hire, catering, extension, workshop material 2009	1,500.00		1,500.00
Room hire, catering, extension, workshop material 2010	1,500.00		2,200.00
Farmnotes publications	1,500.00		1,500.00
Peter Magarey visit 2009	6,050.00		6,050.00
Peter Magarey visit 2010	6,050.00		6,050.00
Regional profiles	600.00		1,000.00
Final report	200.00		200.00
Total	20,000.00		20,000.00
Add 10 % GST	2,000.00		2,000.00
Total funds requested from GWRDC	22,000.00	**Total Expended**	22,000
		Remitted to GWRDC	0

Department of Agriculture and Food
GOVERNMENT OF WESTERN AUSTRALIA

Australian Government
Grape and Wine Research and Development Corporation

Developing long term strategies for the control of Downy mildew in Western Australian vineyards.

The 2008/09 growing season in the south-west of WA was one of the most severe for downy mildew of grape (*Plasmopara viticola*) seen in the state since its first detection in 1998. Large rain events occurred during September, October and November of 2008 that lead to extended flowering periods and resulted in a severe outbreak of the disease on foliage and bunches that lead to loss of yield and quality.

DAFWA and GWRDC have jointly funded a research project on Downy mildew as a result of the severe weather conditions experienced last season. This work is to include grower education on old and new aspects of Downy mildew of grapevines including infection periods and control and management options in the short and long term. The work is to also include workshops and possible design of a weather based support tool for predicting Downy mildew primary and secondary infection events.

Peter Magarey a senior plant pathologist from South Australia will be presenting two workshops:

Margaret River 25th of August

Frankland 27th of August

9am to 2pm: Morning tea and lunch provided.

The Margaret River workshop will be held at the Margaret River Education Campus and the Frankland workshop will be held at the Alkoomi wines function centre. These regions have been chosen due to the severity of Downy mildew last season and as a result of new records of the disease. Peter will also present information on Powdery mildew and the role of managing inoculum during winter to minimise the risk during the growing season.

Please RSVP for catering purposes to myself via email andrew.taylor@agric.wa.gov.au or phone 9780 6241 by the 21st August.

Upcoming event: A group of interstate and international experts on trunk diseases of grapevines will be in WA from the 2nd to 6th of Nov 2009 and visiting the Swan Valley, Gt Southern and Margaret River regions. Interested growers please contact me on the above details.

Department of Agriculture and Food

GOVERNMENT OF WESTERN AUSTRALIA

GRAPE AND WINE UPDATES
Spring Vine Health

Seminars to provide latest information on Research and Development being conducted in WA for the grape and wine industry. Practical advice that can be implemented this season. Opportunities for discussion on each topic presented.

Regional seminars for grape and wine producers

Mildew management: powdery and downy
Peter Magarey, Plant Pathologist, Magarey Plant Pathology, South Australia

Problem pests: longtailed mealybug, six spotted mite, apple looper
Stewart Learmonth, Horticulture Entomologist, DAFWA

Neglected vineyards and legislation
Glen Coupar and David Hill, Biosecurity Officers & Dennis Rafferty, Manager Invasive Species, DAFWA

Vineyard energy management and Entwine
Keith Pekin, Industry Development Officer, Wine Industry Association of WA

Climate change impacts on viticulture in WA
Nyamdorj Namjildorj, Postgraduate Student, Curtin University of Technology

Smoke taint risk management tools
Glynn Ward, Premium Wine Project Manager, DAFWA

Alternative varieties for the wine industry of WA *including wine tasting*
Kristen Kennison, Viticulture Research and Development Officer, DAFWA

SWAN VALLEY
Tuesday 21 September
Swan Valley Oasis Resort
10250 West Swan Road

BUNBURY
Wednesday 22 September
Department of Agriculture and Food
South West Highway

MARGARET RIVER
Thursday 23 September
Australis Margaret River
Wallcliffe Road

Time: 8:30 am to 12:30 pm
Cost: No charge
Refreshments provided

Please RSVP Friday 17 September
Tel: 9777 0000
E-mail: diana.fisher@agric.wa.gov.au

Curtin University of Technology

GWRDC Grape and Wine Research and Development Corporation

Wine Industry Association Western Australia

Magarey Plant Pathology

National Wine & Grape Industry Centre

Western Australian Vine Improvement Association WAVIA