Murray Valley Winegrowers' Inc

Australian Government
Grape and Wine Research and Development Corporation

REDUCING POWDERY MILDEW IN THE VINEYARD



FINAL REPORT to
GRAPE AND WINE RESEARCH & DEVELOPMENT CORPORATION

Project Number: **RT 05/01-2**

Principal Investigator: **Liz McGuire**

Research Organisation: **Murray Valley Winegrowers' Inc.**

Date: **30th September 2006**

Executive Summary

Powdery mildew in the vineyard is probably the biggest disease concern for growers in the Murray Valley. In an effort to assist growers reduce powdery mildew in the vineyard, two sets of events were held over two seasons.

In the 2005-06 season growers were invited to attend workshops held in Mildura and in Tooleybuc. Due to weather events present at the time, the workshops were expanded to include information on downy mildew as well as powdery mildew. Attendance was good with 90 people attending the Mildura workshop and 30 attending the Tooleybuc workshop. Participants heard from disease scientists and extension staff, chemical representatives and a spray application expert.
Feedback from participants indicated that their expectations of the workshop had been satisfied. Participants indicated that they had heard new information on disease characteristics, chemicals, sprayer set-up and calibration as well as dilute versus concentrate spraying.
Participants indicated that they would like to hear more information on high and low pressure disease programs, cheaper ways to prevent and control disease, rain fastness of chemicals, new chemicals, sprayer set-up, disease symptoms and botrytis in future programs.

In the 2006-07 season taking into consideration the feedback from the 05/06 season season workshop participants, five workshops were run throughout the Murray Valley. The workshops were presented by Rachael McClintock from R & D Viticultural Services and delivered practical disease information on powdery mildew, downy mildew and botrytis. Workshops were proudly sponsored by Landmark, NuFarm, Bayer CropScience and Dow AgroScience.
Participants from the workshop indicated that the information presented in the workshops satisfied their expectations. Participants indicated that they had heard new information on the implications of having too many chemicals in the tank mix, the effects of temperature and humidity on spray effectiveness and vine damage, the use of cultural practices to decrease disease, the importance of a wetting agent and timing of prevention sprays. Of particular interest to participants were the high pressure, low pressure and no income year spray programs.

Both sets of events delivered practical disease information that could be taken back into the vineyard and used to reduce not only powdery mildew but downy mildew and botrytis as well.

Acknowledgements are made to the Grape and Wine Research and Development Corporation for providing funding to this project, it is greatly appreciated.

Background

100% of growers in the 2004-05 vintage who participated in the Murray Valley Industry Development Committee (IDC) 2005-06 projects process approved a 2005-06 project on powdery mildew (characteristics, management and control).

Powdery mildew has been given attention on many occasions. Its economic importance however required renewed efforts to ensure sustainable management of the disease and to maintain the focus on the delivery of clean fruit that is suitable for winemaking.

Objectives

- To emphasize the importance of the disease powdery mildew to Murray Valley Winegrape growers.
- To provide the opportunity for human capacity building.
- To reduce economic and environmental damages and loss through the extension of up to date information on powdery mildew characteristics, prevention, control and management.
- To network with local winery representatives and chemical resellers to increase the number of growers attending workshops.
- Expectations that 200 growers total take part in the workshops, 30 from Robinvale and 30 from Swan Hill with the remainder from the NSW and Victorian sides of the Murray Darling region.

Method

A series of workshops were run over two seasons to increase the awareness of not only powdery mildew but downy mildew and botrytis.

Workshop series one

Two disease workshops were organised for the beginning of November in the 2005/06 season. One workshop was held in Tooleybuc and one workshop was held in Mildura (see invitations in Appendix 1).
Key wineries in the area were consulted in regards to the types of information they thought growers needed to hear to improve disease management in the vineyard. The wineries contacted included Hardy Wines, Fosters and Andrew Peace Wines. The wineries consulted were asked to invite growers that in their opinion required assistance in disease management.
Both workshops had the same messages with slight changes to presenters as listed below:
Tooleybuc Workshop

1. Greg Moulds - NSW DPI - The characteristics of powdery and downy mildew.
2. Mark Goldsack - Bayercropscience - Propser - product characteristics and use in chemical programs.
3. Ben Coombe - Nufarm - Cabrio - product characteristics and use in chemical programs.
4. Mario Azzopardi - Jaeguar Australia - Peritec - Trial permit for use on powdery and downy mildew in grapes.
5. John Lopresti - VIC DPI - Research to Practice Spray application and coverage.

Mildura Workshop

1. Bob Emmette - VIC DPI - The characteristics of powdery and downy mildew.
2. Mark Goldsack - Bayercropscience - Propser - product characteristics and use in chemical programs.
3. Harry Pickering - Nufarm - Cabrio - product characteristics and use in chemical programs.
4. Andrew Warrdle - Farmoz - Axiom plus - product characteristics and the supply situation.
5. John Lopresti - VIC DPI - Research to Practice Spray application and coverage.

Workshop - Series Two

An extension of the “Reducing powdery mildew in the vineyard” project was requested and granted by GWRDC.
Five small disease workshops were run in August of the 2006/07 season. Growers were invited (see Appendix 2) to attend workshops in Mildura, Coomealla, Red Cliffs,

Robinvale and Tooleybuc. Workshop information was presented by Rachael McClintock from R &D Viticultural Services with workshop size was limited to thirty participants per workshop.
Topics covered workshop series two included:

1. High and low pressure disease programs
2. Cheaper methods of control and cheaper disease programs
3. Selection of chemicals
4. Disease symptoms
5. Disease monitoring
6. Timing of application
7. What if powdery is found?
8. Water rates.

Workshops were supported by Landmark, NuFarm, Bayer CropScience and Dow AgroScience. Landmark representatives were asked to invite and spread the word to winegrape growers in the field.

Results / Discussion

Workshop - Series One

Workshop series one was held in November around the same time of some favourable downy mildew weather. Due to this event, the workshop series were altered to include information on downy mildew.

Attendance at both workshops was good with approximately 90 participating in the Mildura workshop and approximately 30 participating in the Tooleybuc workshop. The workshops were both held in the evening allowing growers the opportunity to complete a full day of work before attending the workshop.

Growers were provided with practical information from presenters. Handouts provided at the workshop are located in Appendix 3.

The workshop was split into two sections with a formal break in the middle to ensure growers were able absorb the maximum amount of information on offer. The formal break allowed growers to network with each other and the presenters. This relaxed environment allowed the workshop participants the opportunity to ask questions specific to their own situations and have the opinion of surrounding peers and experts.

Sixty one workshop participants filled in the evaluation sheet (see Appendix 4). All participants indicated that the session was informative and worth while attending. Growers came to the session with the expectations of hearing about diseases, chemicals and sprayer set-up & technique.
All growers who filled in the evaluation felt that their expectations were satisfied by the session information. Growers indicated that they heard new information on disease characteristics, chemicals, sprayer set-up and calibration as well as dilute versus concentrate spraying. Growers indicated that they would like to hear more information on high and low pressure disease programs, cheaper ways to prevent and control disease, rain fastness of chemicals, new chemicals, sprayer set-up and disease symptoms in future programs.

Interestingly many of the participants commented that they had attend the workshop the hear information on chemicals. They indicated that they were looking for new chemical groups and were more conscious of chemical effectiveness, resistance and the effect of chemicals on the surrounding environment.

A newsletter article was compiled and printed in the Murray Valley Winegrowers' Inc newsletter "The Grapevine" (see Appendix 5). This article summarised the workshops for growers who were unable to attend.

After consultation with GWRDC to extend the project to encompass the 2006/07 season a pre-season session was developed from the comments made by growers in the evaluation process.

Workshop - Series Two

The second series of disease workshops were held at the beginning of the August 2006 pre-season to ensure growers had the opportunity to change preventative programs according to information presented if required.

Workshops information included information on powdery mildew in accordance with the project as well as information on downy mildew and botrytis in accordance with the information growers wished to hear more about.

Workshops were held in five different locations in an effort to make attendance more convenient to growers. Workshops were also limited to thirty participants per workshop in order to create a comfortable environment for participant / presenter interaction.

Workshop information was presented by Rachael McClintock, a pest and disease consultant that had recently set up operations in the Murray Valley. Handouts were made available to workshop participants (see Appendix 6) and a poster displaying the symptoms of powdery mildew, downy mildew and botrytis were developed for growers to stick up in the shed (see Appendix 7).
Of particular interest to growers were the high disease pressure, low disease pressure and no income year disease program comparisons. These comparisons gave growers a good idea of what sort of chemicals they could use in each situation and what sort of cost was involved. Unfortunately due to legality issues the presenter did not provide this information in a handout form for growers to take away.

With a capacity for 150 participants in total, the workshops attracted approximately 75 participants. Workshop participants were given the opportunity to network with and ask questions of peers and the presenter in a formal break.

Fifty one participants contributed to the evaluation process. Results from the evaluation indicated that 100% of participants who filled out the evaluation thought the workshop was worth while attending and that their expectations were satisfied by the information presented. Some comments made on the evaluation indicated that participants heard new information on the implications of having too many chemicals in the tank mix, the effects of temperature and humidity on spray effectiveness and vine damage, the use of cultural practices to decrease disease, importance of a wetting agent and the importance of timing for prevention sprays, etc.

A newsletter article was compiled and printed in the Murray Valley Winegrowers' Inc newsletter "The Grapevine" (see Appendix 8). This article summarised the main points of the workshops for growers who were unable to attend.

Outcomes / Conclusion

Overall the workshops provided information that was up to date and relevant to reducing powdery mildew, downy mildew and botrytis in the vineyard.

The workshops provided an opportunity for human capacity building, with participants networking with peers and presenters. The formal breaks created a comfortable environment for questions specific to participant's situations to be asked and answered.

The presenters were very knowledgeable about disease characteristics, prevention, control and management. They delivered information that was easily understood. Acknowledgements are made to all presenters involved in both series of workshops, their contributions are greatly appreciated.

The information presented in both series of workshops has created the opportunity for growers to reduce the economic and environmental damages and loss disease can cause in the vineyard and to the business.

The network developed with local wineries and chemical resellers provided the opportunity for new ideas to be incorporated into the workshop programs and provided a conduit to spread the information further. These networks were a useful tool and will be utilised in future grower programs.

While the number of participants didn't reach expectations in all areas, the importance of disease management was conveyed with the potential for the message to spread to the larger winegrape community.

Feedback from the workshops was positive and growers took information away to implement or re-emphasize in the vineyard.

Acknowledgements are made to the Grape and Wine Research and Development Corporation for providing funding for this project.

Budget Reconciliation

Budget	Funding required from GWRDC	Actual Expenditure
Presenters	2,000.00	2,000.00
Venue	450.00	450.00
Advertising	700.00	700.00
Handouts, signs & equipment	600.00	600.00
Travel & accomodation	900.00	885.00
Aministration	365.00	365.00
	7,000.00	
Total	12,015.00	
Add 10 % GST	1,201.50	
Total funds requested from GWRDC	13,216.50	
Total funds received from GWRDC	5,500.00	
Total Expended		5,500.00
Remitted to GWRDC		0

APPENDIX 1

Murray Valley Winegrowers' Inc

Update your skills in a workshop on:

1. **Powdery Mildew,**
2. **Downy Mildew,**
3. **Chemicals and**
4. **Spray Application.**

When:

Wednesday 9th November at the Tooleybuc Club
OR
Thursday 10th November at DPI Irymple

Time: 4.00 - 8.00pm

RSVP: Tuesday 8th November

TO REGISTER

Phone Murray Valley Winegrowers on (03) 5021 3911 or fax the following to (03) 5023 2335.

☐ **I would like to attend the workshop on the 9th November at the Tooleybuc Club.**

☐ **I would like to attend the workshop on the 10th November at DPI Irymple.**

Name(s)……..

Phone Number…… ……

APPENDIX 2

Murray Valley
Winegrowers' Inc

DISEASE WORKSHOPS

Aim: Cutting costs and maintaining good disease cover in the coming season.

Topics to be covered during the session include:

High and low pressure disease programs	Disease monitoring
Cheaper methods of control and cheaper disease programs	Timing of application
Selection of chemicals (mode of action)	What to use if powdery is found?
Disease symptoms	Water rates

Details

Presenter: Rachael McClintock - R & D Viticultural Services *Rachael McClintock is a new consultant in the Murray Valley and brings with her a wealth of knowledge and experience specifically in the area of pest & disease.*			
Tuesday 1st August 2006			
Mildura	Mildura Golf Club	7:30am - 9:30 am	Breakfast provided
Red Cliffs	Red Cliffs Club	11am - 1:30pm	Lunch provided
Coomealla	Coomy Club	4:30pm - 7pm	Dinner provided
Wednesday 2nd August 2006			
Robinvale	Robinvale Golf Club	11am - 1:30pm	Lunch provided
Nyah	Tooleybuc Sporting Club	4:30pm - 7pm	Dinner provided
Maximum of 30 participants per workshop			
Participants are asked to bring last seasons spray diary, water rates, disease outbreak records etc to the workshop			

PTO

RSVP

I would like to attend the disease workshop.

Please RSVP by Thursday the 27th of July, by calling Murray Valley Winegrowers' Inc on 5021 3911, fax the following to 5023 2335 or email:
liz.mcguire@murrayvalleywinegrapes.com.au

Please nominate the workshop you would like to attend and the number of people who will be attending. **Remember places are limited.**

Mildura Golf Club	Tuesday 1st August	
Red Cliffs Club	Tuesday 1st August	
Coomealla Sporting Club	Tuesday 1st August	
Robinvale Golf Club	Wednesday 2nd August	
Tooleybuc Sporting Club	Wednesday 2nd August	

Name/s:.....

Contact phone number:.....

Proudly supported by:

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an AWB company

APPENDIX 3

DEPARTMENT OF
PRIMARY INDUSTRIES

Powdery mildew of grapevines

Bob Emmett: Department of Primary Industries, Mildura, Vic.
Roger Magarey: Formerly of Department of Primary Industries, Mildura, Vic.
Peter Magarey, Malcolm Wachtel and Lesley Biggins: South Australian Research and Development Institute, Loxton Research Centre, Loxton, S.A.

How it starts – Disease begins at budburst

The powdery mildew fungus can enter the vineyard from:

- Spores produced on 'flag' shoots that grow from buds infected in the previous season. These shoots are covered in mildew;
- Spores released from fruiting bodies (cleistothecia) in vine bark or leaf litter after 2.5mm of rain or irrigation at temperatures of 10-30°C; and
- Spores blown in from adjacent diseased vineyards (usually from flowering onwards).

Early Season Control Easy

Late Season Control Difficult

Result – Leaf blotches

- Yellow-green blotches (3-10mm) develop on the upper surface of leaves. Powdery ash-grey growth occurs on the upper or lower surface of leaf blotches. Small veins within blotches are brown.
- At first, leaf blotches usually appear on only 1-10 vines per hectare.
- Blotches appear in clumps on leaves near flag shoots or alone on individual leaves dispersed through the vineyard.



Red-brown blotches on canes

The spread – Mild weather

- The earlier the disease starts to spread, the greater the likelihood of crop loss.

Once present in the vineyard, the disease will spread continuously unless:

- fungicide sprays are applied, and/or
- very hot (heat-wave) or very cold weather occurs.

- **Rapid spread can occur in the first 40 days after budburst.**



Berries covered by grey-white mildew

Result – Rapid multiplication

The mildew population increases exponentially:

- Crop loss and berry infection can begin by flowering time.
- Diseased berry surface area can double in two weeks.
- As the epidemic gathers momentum fungicides become less effective.
- Berries are susceptible to infection until just before berry softening.

Control – 2, 4, 6 and 10

- **A preventative spray program early in the season is essential** in vineyards with a history of disease.
- Fungicides should be applied at **2, 4, 6, and 10 weeks after budburst.**
- Additional sprays at 2-3 week intervals between berry set (10 weeks after budburst) and berry softening may be needed on susceptible varieties.



Web-like patterns on berries where the powdery mildew fungus has grown

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Prepared by Lisa Mitchell

DEPARTMENT OF
PRIMARY INDUSTRIES

Downy mildew of grapevines

Bob Emmett: Department of Primary Industries, Mildura, Vic.
Roger Magarey: Formerly of Department of Primary Industries, Mildura, Vic.
Peter Magarey: South Australian Research and Development Institute, Loxton Research Centre, Loxton, S.A.

How it starts – 10:10:24

Conditions for primary infection:

- At least 10mm of rain when temperatures are at least 10°C over a 24 hour period.
- Wet soil for the first 16 hours and rain splash during the next 8 hours.
- After rain splash, wet foliage for 45 degree(°C)-hours.

Result – Oilspots

Yellow spots with a slight chocolate colored halo when young:

- One or two spots every 50 metres of vine row.
- Spots develop in 5-8 days in warm weather or longer if its cool.



Yellow oil spots

The spread – Warm wet night

Conditions for secondary infection:

- Oil spots must be present.
- Very high humidity (>98%) or rain for at least 4 hours during the night, when temperatures exceed 13°C, followed by wet leaves and bunches for at least 2 hours (45°C-hours).

Result – More oil spots

Often 50 to 100 times more than before.

- If secondary infection occurs early in the season, 300-500 downy mildew oil spots can produce 30,000-50,000 oil spots 5-8 days later.
- Bunches are very susceptible at and near flowering.



White downy growth on the underside of leaves

Control – Spray timing is crucial

Post-infection (eradicant) fungicides:

- Apply as soon as possible **after** an infection period and **before** the oil spots appear.

Pre-infection (protectant) fungicides:

- Must be applied to cover all foliage **before** an infection period.
- Pre-infection fungicides protect foliage from **new** infections but will not prevent oil spot appearance if applied **after** an infection period.



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Prepared by Lisa Mitchell

DEPARTMENT OF
PRIMARY INDUSTRIES

Horticulture Hotline

Lisa Mitchell, David Madge and Bob Emmett: Department of Primary Industries - Mildura, Vic

- Horticulture Hotline has been delivering grape disease and pest information to growers since 1988



- Information on pest and disease status and management is distributed frequently, during the growing season

- Information in each Hotline message is derived from:
  - vineyard monitoring
  - automatic weather stations
  - computer models
  - interpretation by experienced researchers



- The information includes predictions of lightbrown apple moth activity and alerts on downy mildew infections



- Horticulture Hotline messages have been delivered to growers through:
  - 24-hour recorded phone message
  - email
  - newspaper articles





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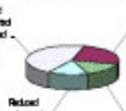
Cooperative Research Centre for Viticulture

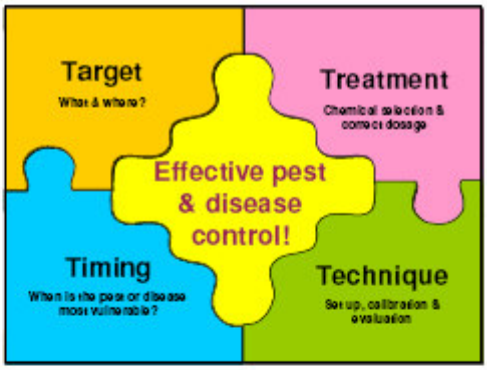
The bottom line....

Case study 1
A vineyard manager was able to reduce pesticide usage over one season by 30% and total spraying costs by 50%, resulting in savings of $1/10 per hectare while still maintaining excellent disease control after attending a spray application workshop

Case study 2
Another grape grower was able to reduce his copper sprays by 40% and sulphur sprays by 10% using practical advice provided in the spray workshop resulting in an immediate reduction in total spraying costs of 15%

Key outcomes resulting from Research to Practice®: Spray Application in Viticulture workshops (Percentage of participants)





Cooperative Research Centre for Viticulture

Chemical use in viticulture

- Spraying as required based on monitoring/ disease pressure
  - 'medium risk'
  - requires good data capture and record keeping
  - very good spray techniques required
- Calender/ Preventative sprays
  - 'lower risk'
  - early season sprays with good coverage are critical
  - can be costly if not done efficiently
- Focus on 'smarter' use of pesticides
- Conserve pesticides as a valuable resource
- Further understanding of pest and diseases is important

Cooperative Research Centre for Viticulture

Strategic chemical use - an example

- Integrated rust mite control might include:
  - Monitoring for migration
  - Correct timing of treatment
    - Chardonnay: woolly bud
    - Cabernet sauvignon: bud swell- woolly bud
  - Optimum environmental conditions when spraying
    - Temperature at time of application ≥ 15 °C
  - Recirculating sprayer to reduce wastage and off target impacts
  - Preserving beneficial predatory mites
  - Minimise use of incompatible pesticides
    - Chlorpyrifos: Lorsban®, lime sulphur
    - Synthetic pyrethroids, pyrethroids, OP's
    - Dithiocarbamates eg. Mancozeb®, Dithane®,
    - Benzimidazoles eg. benomyl, Benlate®, Bavistin®, Spin®

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Effective pesticide application requires...



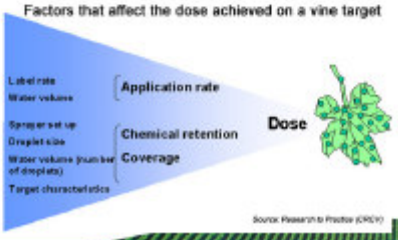
- Good coverage of target
  - percentage of target area covered by deposits (%)
  - even coverage throughout canopy is the key!
- Correct dose
  - amount of chemical deposited on the target surface (µg per square cm of leaf)
  - enough chemical in each droplet deposited to kill the pest or disease (Also known as the "Lethal dose")

Most common reason for not achieving coverage and/or dose is simply "not hitting the target"

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Rate + Retention = Coverage + Dose

Factors that affect the dose achieved on a vine target



Source: Research to Practice (CRCV)

What is the target?

- Biological target:
  - the pest to be controlled
    - eg. powdery mildew, LSAM
- Application target:
  - where the spray must be placed to reach the pest
    - eg. the bunches for Botrytis
- Targets 'drive' the spray application process
  - will determine spray timing, chemical selection, sprayer set up, spray volumes

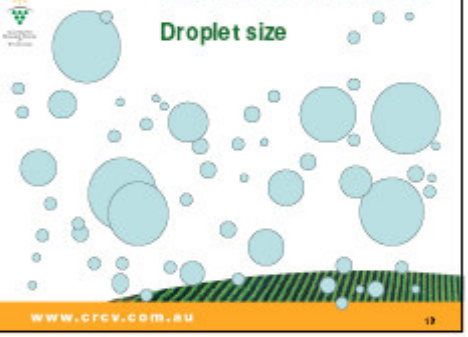
Application target characteristics

- Cordon, canes, spurs
  - Dry bark, difficult to wet
  - Generally small target area early season
- Leaves
  - Surface characteristics
    - Hairs, wax, stomata
    - Upper/lower surfaces
    - Changes with leaf age eg. increasing leaf area
- Shoots
  - Surface characteristics
  - Changes with age ie. harden into canes
  - Reduced movement of hardened canes during spraying

Application target characteristics

- Flowers and Berries
  - position within canopy
    - access to sprays
  - configuration
    - flowers can be difficult targets
    - loose or tight bunches
  - surface characteristics
    - flower caps on or off
    - berries waxy/water repellent
  - changes during development
    - uphill berry set; bunch closure; veraison

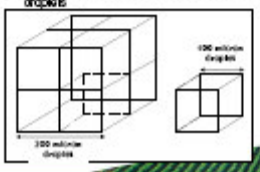
Droplet size



Droplet size and coverage



- 'Size' = diameter
- Measured in microns (µm)
- 1 mm = 1000 microns
- Many small droplets needed to equal volume contained in a few larger droplets



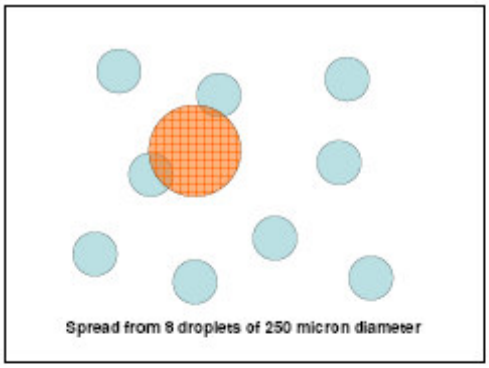
1 droplet of 200 microns

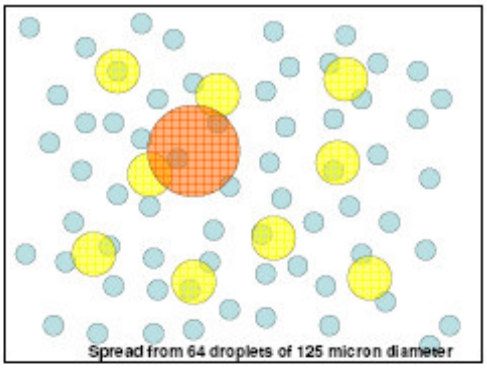
= 8 droplets of 100 microns

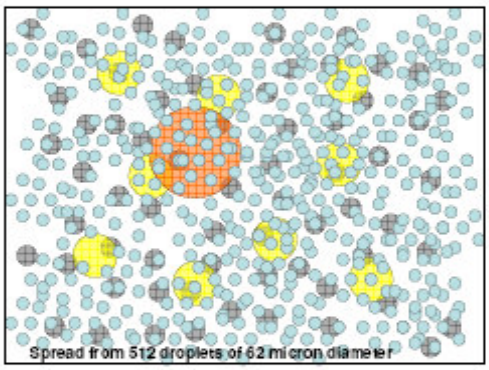
= 64 droplets of 50 microns

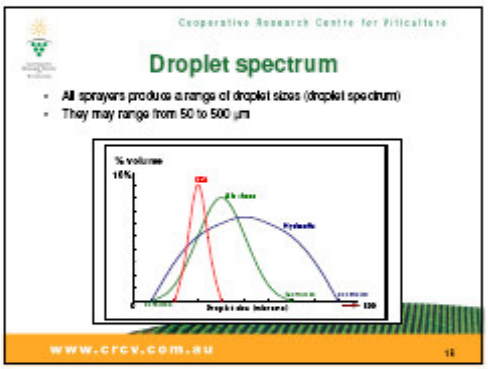


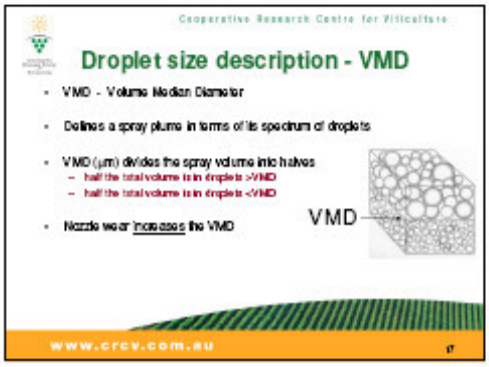
Spread from one droplet of say 500 micron diameter


Spread from 8 droplets of 250 micron diameter


Spread from 64 droplets of 125 micron diameter


Spread from 512 droplets of 62 micron diameter

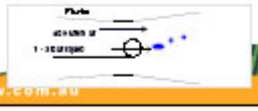

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Droplet spectrum
All sprayers produce a range of droplet sizes (droplet spectrum)
They may range from 50 to 500 µm
% volume
100
Droplet size interval
www.crcv.com.au


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Droplet size description - VMD
VMD - Volume Median Diameter
Defines a spray plume in terms of its spectrum of droplets
VMD (µm) divides the spray volume into halves
half the total volume is in droplets >VMD
half the total volume is in droplets <VMD
Nozzle wear increases the VMD
VMD
www.crcv.com.au


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Ideal droplet size
Optimum droplet size will be influenced by:
Chemical-target interaction
translaminars require minimum drying time
application target - waxy leaves, flowers, bunches or dry bark
biological target - mobile or static
Weather conditions
wind, temperature, humidity
Rule of thumb, 70 - 250 µm for fungicide and insecticide sprays
Aim for VMD of 100 - 150 microns
As droplet size range widens, need more volume to achieve good coverage
www.crcv.com.au

Air shear nozzles

- High speed air shatters liquid into droplets
- Relatively narrow droplet spectrum
- Several air shear designs
  - liquid feed, fins, teardrop
- Can use various size trumpets or canons
- Droplet size increases with:
  - lower air speed through trumpet
  - increasing liquid flowrates
    - very high flowrates will flood heads



Droplet size - Air shear nozzle

- Silvan Turbomiser P80 - Lower right diffuser head
- Red restrictor disk

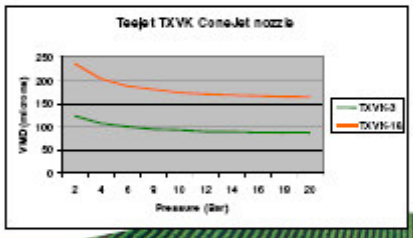
Restrictor	Liquid pressure (kPa)	Flow rate (L/hr)	VMD (um)	50.8 um:%-256 um
1	100	102	82	74
2	100	131	82	74
3	100	166	88	75
4	100	194	89	76
5	100	217	96	75
6	90	278	102	78
7	80	301	103	80

Hydraulic nozzles

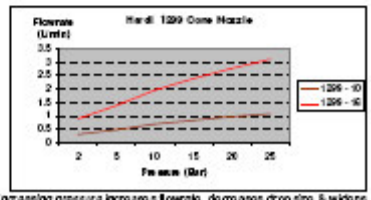
- Droplet size and flowrate determined by liquid pressure and orifice size
- Hollow cone
  - Hardi Ceramic 1299 Series
  - Teejet ConeJet VariFlo®
  - Lurmark HollowTip™
  - Albuz ATR Hollow cone
- To produce enough droplets in the 70 - 250 µm range:
  - use more (not larger) hollow cone nozzles
  - doublets or triplets
- Avoid using pump pressure > 10 bar



Droplet size - Hydraulic nozzles

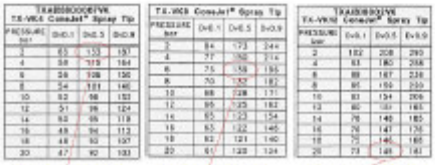


Nozzle flowrate - Hydraulic nozzles



Increasing pressure increases flowrate, decreases drop size & widens spray angle for cone nozzles - BUT also increases rate of nozzle wear

Droplet size - Hydraulic nozzles



TXVK ConeJet® Spray Tip			
PRESSURE bar	Dv0.1	Dv0.5	Dv0.9
2	84	173	244
4	77	162	214
6	75	156	195
8	70	152	182
10	68	228	171
12	65	125	162
14	65	123	154
16	63	122	146
18	62	121	140
20	61	120	134

TXVK ConeJet® Spray Tip			
PRESSURE bar	Dv0.1	Dv0.5	Dv0.9
2	182	308	390
4	83	180	268
6	89	167	230
8	85	159	209
10	83	154	200
12	80	150	195
14	78	148	192
16	76	147	190
18	75	146	188
20	73	146	187

0.22 litres/minute at 2 bar

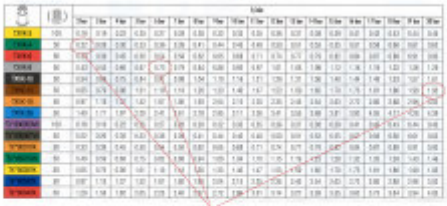
0.73 litres/minute at 6 bar

1.45 litres/minute at 20 bar

- Selection based on droplet size and flow rate required

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Water flowrate - Hydraulic nozzles



Nozzles producing similar droplets sizes (VMD ~ 140 micron)

Sprayer selection

- Vine canopy controls the application process
- Any sprayer used must be appropriate for your vineyard
  - trellising system
  - various growth stages
  - canopy size
- Potential pitfalls
  - too little or too much air
  - inability to target sprays accurately throughout season
  - limited capacity to manipulate spray quality and air
  - limited access to spare parts/ service
  - poor build quality/ reliability
  - expertise, time to set up equipment

Sprayer selection

- Nozzles
  - Most critical equipment on sprayer
  - Only use high quality, accurate nozzles (worth the extra expense!)
  - Check for wear and calibrate regularly
  - If the flow rate is different to that specified at pressure used, change nozzles
    - nozzles that differ at 5% from specification should be replaced (wear)
- Pressure gauges
  - used to accurately set flow rates and indicate in-field faults
  - choose gauge with diaphragm and glycerine (dampens vibration)
  - have a spare pressure gauge available
    - replacement or to check if sprayer gauge is faulty
  - Most common fault is needle not returning to zero
    - cannot be repaired so replace

Evaluating spray coverage - Why?

- Leap of faith when spraying!!
- How can you tell where the spray ended up?
- How much was deposited?
- Crude monitoring tools
  - pest and disease control at end of season
  - powdery mildew in the tops of vines as an indicator of poor coverage
- Don't want to wait for final biological result
  - it may be too late!
- Options
  - Visual assessment
  - Fluorescent dyes
  - Water sensitive papers



Evaluating coverage

- Visual assessment
- Reasonable guide when dilute spraying
  - must jump out of tractor cab and have a look
  - look for dry lower leaf surfaces and within inner canopy
- Fine droplets dry on impact making assessment difficult
  - little value when using most air-assisted sprayers and concentrate spraying
- Use of other coverage indicators?
  - kaolin-based powders e.g. Surround
    - not registered for grapes (trials in progress)
  - breaking open grape bunches
  - beer bottle in the canopy

Evaluating coverage

- Fluorescens dyes
- Fluorescent pigment sprayed onto foliage
- Deposits assessed using UV light
- Dyes can show:
  - capture of spray inside canopy
  - deposits on berries
  - coverage inside grape bunches
  - off-target impacts
- Droplet number rating chart can be used
- Should be done at least once in life of sprayer

Evaluating coverage

- Water Sensitive Cards (WSC)
- Give true relative indication of droplet size from different nozzles
- Drops spread and appear twice as large
- Under-estimate coverage of fine drops (<100 µm)
- Don't show amount of chemical deposited
- High humidity (>60% RH) can stain WSC & change spread factor
- Good for relatively quick assessment
- Use as coverage guide only
  - they don't collect droplets like foliage

Water Sensitive Cards (WSC)

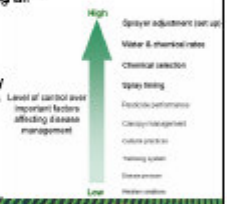
- Staple papers to foliage before spraying
- Spray poles
- Allow a repeatable, fixed position target
- Place in most difficult to spray canopies
  - centre of vines
- Keep spray deposit records
  - provides permanent record
  - record sprayer adjustments, climatic conditions & growth stage

Water Sensitive Cards (WSC)

- Comparing spray equipment
- Difficult to compare deposit landed between air shear and pressure nozzle applications
  - should only compare similar sized drops
- Use to compare different sprayer set ups
- Use to even out coverage
  - from outside to inside of canopy
  - from top to bottom of canopy
- WSC deposits can be regarded as a worst case

Pesticide application process

- Many factors contribute to the effectiveness or efficiency of a chemical control program
- Some of these can be controlled
  - many can't be!
- 'Simplest' approach is to look at spray application as a step by step process
- Attempt to optimise each step or minimise likelihood of failure



Sprayer set up and calibration

- Set up ("configuration", "adjusting")
  - = Adjusting travel speed; air volume, speed & direction; nozzle size and direction etc.
  - Aims to maximise coverage and minimise wastage
  - To match the canopy, weather and target
- Calibration
  - After the set up has been optimised
  - = Measuring volume output per minute and travel speed
  - Tells you what volume leaves the sprayer per 100m or per hectare
  - Tells you nothing about what's required for a particular canopy, weather, pest or disease...

Sprayer set up

- Setting up involves three components
- The canopy
  - biological target
  - application target/ spray zone
- Air (carrier) - delivers chemical to the target
- Liquid volume (spray mixture) - ensures even coating of target

Increasing water volumes will not compensate for poor air set up

Sprayer set up process

Prior to the first spray application each season

Before each spray application during the season



Sprayer set up - How often?

- Ideally set up sprayer as canopy changes
  - ie. budburst, pre-flowering, berry set, veraison
  - 4 - 5 times per season
- Set up at least before critical sprays
  - eg. Flowering and pre-bunch closure for *Botrytis* sprays
  - eg. Pre- and post-flowering, and before lifting foliage wires for powdery mildew sprays
- Set up is more than just changing spray volumes!
- Initially may take some time to optimise a sprayer for your particular canopies

Air quality - role of air

- Air carries droplets from sprayer to application target
  - air controls spray penetration into canopy
- Air set-up depends on:
  - targets, growth stage, canopy architecture
- Air quality is the right combination of air volume, direction and speed for a specific target
- Depending on sprayer type, can adjust:
  - air volume, air speed, air convergence/ mixing and air direction
  - fan rotation speed, blade angling, fan cowling and gearbox all influence air quality produced

Visual cues for adjusting air quality

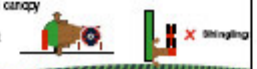
- Ideally spray plume penetrates and stalls inside canopy
  - occasional puffing through to other side even in the densest parts of the vine
- Spray plume passing along or around outside of canopy
  - too much air ('shingling')
- Spray plume forced upwards or beyond the canopy
  - too much air
  - redirect converging air streams
- Air direction
  - flagging tape on poles

Optimise air volume

- During most of the season sprayers produce too much air for the vine canopy
- To reduce air volume (as canopy):
- Travel faster
- Reduce fan speed, (gearbox or RPM)
- Reduce blade pitch
- May be able to 'bleed' air from outlets

Optimise air speed

- Air velocity from some sprayers can easily push spray plume through and beyond canopy
- High velocity air can cause 'shingling'
  - leaves overlap and 'wall off' inner canopy
- To reduce air speed (as canopy):
- Travel faster
  Reduce fan speed (gearbox or RPM)
- Increase distance of outlet from canopy
  - angle heads / ducts
- Enlarge the size of the air outlet



Adjust travel speed

- Should be selected to allow correct air to be delivered to canopy
  - within practical speed limits
- Slower travel delivers more air and spray volume per metre of row
- Faster travel delivers less per metre of row
  - drive faster if too much air at canopy



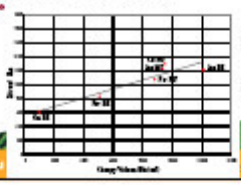
Optimising water volumes

- Common reasons for incorrect application/ water volumes
- Sprayer Calibration
  - damaged or worn nozzles, inaccurate pressure gauge
  - leaks from hoses and fittings, clogged suction filters and strainers
  - travel speed errors
  - wrong spray tank/ dilute (don't depend on site gauge)
  - inaccurate scales and measuring jugs
- Application target
  - not matching volumes to target size/ characteristics
  - not matching volumes to weather conditions
  - minimum volumes on pesticide labels

Optimising water volumes

- Early season application volumes
  - 25 - 50% of full canopy volume
  - trellising system dictates lowest volume used early season
  - chemical labels may set minimum volumes
  - application target will influence volume required
- Volumes should be increased in 3 or 4 steps during season
  - as canopy increases in size
  - whether concentrate or dilute spraying

Canopy hand lance trials 1997



Sprayer setup - Step 1

- ID pest and pest pressure
- Choose chemical
  - including careful selection of adjuvants if required
- ID application target
  - what part of the vine canopy is being sprayed?
- You now know what you want to achieve with this spray application

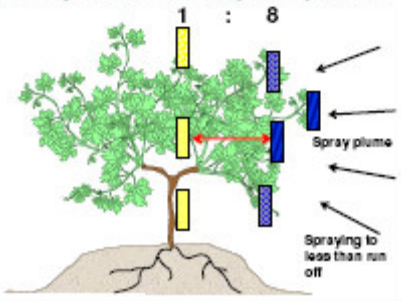
Sprayer setup - Step 2

- Adjust air for best deposition
- Weaken/strengthen air at canopy
  - travel speed
  - air output from fan
  - direct ducts
- Air output will determine total coverage and evenness of coverage

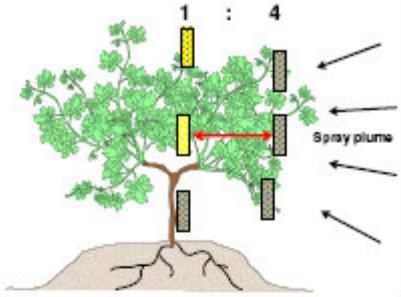
Step 3

- Adjust water volume:
- For dilute spraying
  - (Increase/ decrease flow rate) to adequately wet the 'hardest-to-get-to' target
  - use adjuvant in test runs if it will be used during spraying
- For concentrate spraying
  - use volume that will give good coverage and suitable work rates
  - still need to achieve adequate coverage inside inner canopy
- Your sprayer is now set up to give you cover and dose = CONTROL

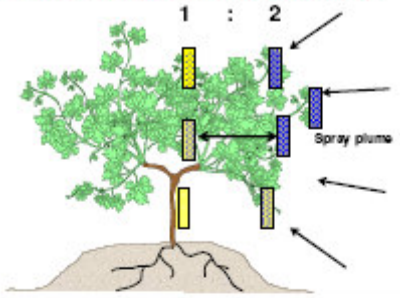
Air set-up - How can I improve profile?



Air set-up - Change travel speed?



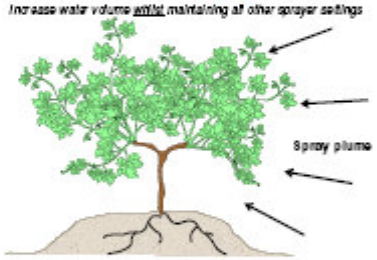
Air set-up - Change direction of ducts?



What water volume to thoroughly wet canopy at best set-up?

500 L/ha → 600 L/ha → 700 L/ha → 800 L/ha

Increase water volume only maintaining all other sprayer settings



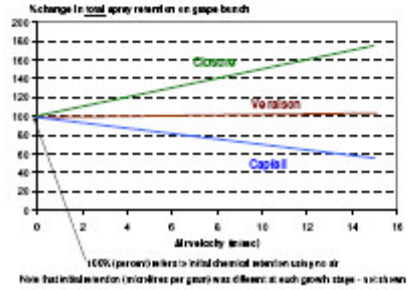
Spraying bunches

- Difficult target due to:
  - variation in bunch positioning
    - determined by canopy management
  - changing bunch structure
    - flowering, bunch closure, veraison Bunches are hard to spray
- Average bunch deposits can be expected to be lower than those on leaves
- Total bunch deposits will increase with increasing application volume

Spraying bunches

- Chemical reception is affected by :
- Liquid volume, drop size, air and adjuvants
- Two stage process
  - droplet transport to bunch
  - droplet retention and spread over and inside bunch
- Suitable air quality gets droplets into canopy & onto bunches
- At and after pre-bunch closure
  - liquid volume and properties will affect amount of chemical retained inside bunches

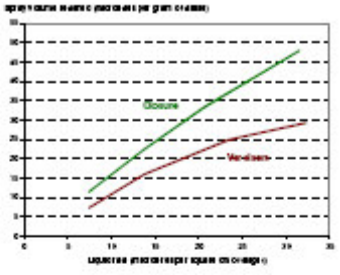
Retention of spray deposits on bunches with increasing air speeds



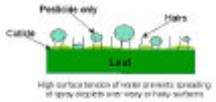
100% (percent) refers to initial chemical retention using no air

Note that initial retention (microlitres per gram) was different at each growth stage - not shown

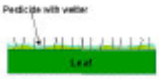
Retention of spray deposits when bunches were sprayed with various volumes



Using spray adjuvants



High surface tension of water prevents spreading of spray droplets over waxy or hairy surfaces



Addition of a surfactant (wetter) lowers surface tension allowing droplets to spread and contact the leaf cuticle

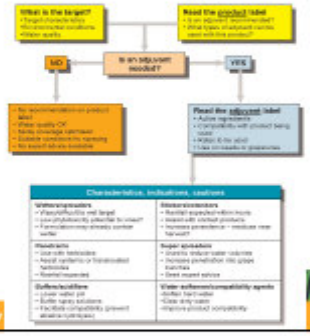
- Common non-ionic wetters/ surfactants used in viticulture
  - BS1000®, Cheqwet® 1000, Shirwet® 1000, Agral® V/I-Wet®, Wetter® 600 LF, Wetter® 1000 LF and Spraymate™ Activator
- Alcohol-based non-ionic products can be phytotoxic to grapevines
  - generally used for weed control/ more resistant crops

Using spray adjuvants

- Pesticides usually contain adjuvants to maximise performance
- Under 'normal' conditions many pesticides perform effectively without additional spray adjuvants
- Adjuvants can maintain pesticide performance when:
  - environmental conditions, application practices or target characteristics less than ideal
  - eg. very dusty leaves, cordon (dry bark) or bunch sprays
- Ideally only to be used with products that recommend incorporation of a 'suitable' adjuvant

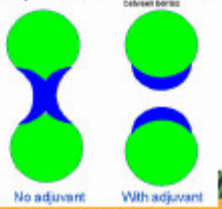
REMEMBER: ALWAYS CHECK THE CHEMICAL LABEL TO ENSURE THAT ADJUVANTS USED ARE COMPATIBLE WITH THE PEST OR DISEASE CONTROL PRODUCT(S) BEING APPLIED. INCORRECT OR EXCESSIVE USE OF A SURFACTANT MAY REDUCE THE EFFECTIVENESS OF ACTIVE INGREDIENTS OR CAUSE DAMAGE TO VINES AND OTHER PLANTS

Decision tree for selecting adjuvants



Bunch spraying with adjuvants

Liquid bridge formation in tight bunches and the affect of adjuvants



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Application volumes & pesticide rates

- Rate/ha phased out in chemical labels for vines
  - use mL/100 L or g/100 L rate
- All labels use standard terminology- 'Dilute' and 'Concentrate' spraying

- For consistency close.....
- When dilute spraying should:
  - match spray volume to target
    - keep adding rate/100 L from label as water volume increases with canopy growth
  - ensure vine canopy is 'thoroughly' wet

- When concentrate spraying need to:
  - know dilute volume to 'thoroughly' wet canopy first
  - calculate amount of chemical needed as if you were dilute spraying
    - mix this amount in your chosen water volume

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Dilute spraying

- Defined by spraying to the POINT OF RUN-OFF (thoroughly wet)
  - use chemical rate (mL or g/100 L) from label
- Larger volumes and range of droplet sizes
- Increase volumes through the season to match canopy

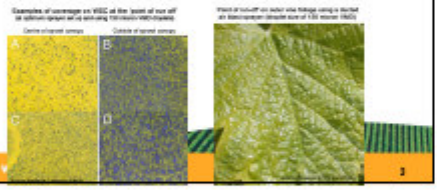
- What is the point of run off?
- Drops collect on, and run-off, outer leaves of canopy
  - can occur well before inner canopy is thoroughly wet
- Beading of drops on target surface?
- Generalised wetness overall
  - some estimation needed
  - water sensitive cards may help

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Point of run off

- This point is only reached once the sprayer is set up to ensure even coverage of inner foliage or bunches

- Most simply defined as *the point where most droplets on outer foliage of a vine canopy begin to join together with some pooling at leaf edges / base of berries in bunches*



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Concentrate spraying

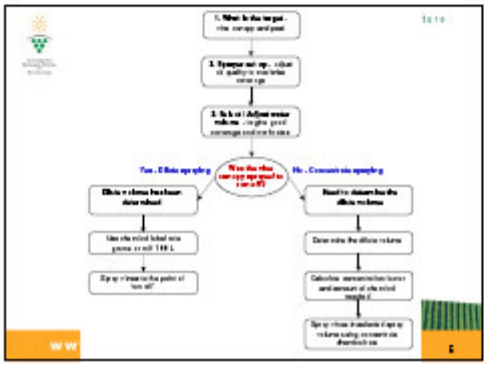
- NOT TO RUN-OFF
  - more effective conversion of spray mixture to useful droplets

- Same amount of chemical applied
  - as would have been applied if dilute spraying

- Concentration of product in tank is increased proportionally
  - as water volume is decreased below the dilute (run off) volume

- Water volume selected to ensure good coverage
  - this is done during sprayer set up

- Spray volumes may be limited by critical comments on label



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Options for determining dilute volumes



- Measure in-field dilute volumes
  - Test spraying to run-off
  - Knapsack sprayer
- District practices/ past experience
  - What has worked before?
- Vine-Row-Volume - 'Unit canopy row'
- AWCARE recommendations

- How close do we need to get to the 'true' canopy dilute volume?
  - Within 10-20% is enough .....
  - If sprayer has been optimised to achieve adequate coverage

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Determining dilute volumes

- Tese spraying so run off:
- Best sprayer set up is determined first and remains unchanged
- Gives relatively accurate dilute volume
- "Easy" procedure when using dilute spraying equipment
- Can use a knapsack sprayer?
- Possible using air shear sprayers on small canopies or early season

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Determining dilute volumes

- Unit Canopy Row (UCR):
- Matches spray volumes and chemical rates to canopy size
- Application volumes measured in Litres/100m
- Can provide initial estimate of dilute application volume
- Has significant limitations

- It can take about 1000 L/ha to saturate:
  - a 1 m x 1 m canopy (medium density)
  - at 3 m row spacing
- This equates to 30 L/100 metres of vine row



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Unit Canopy Row example

1.3 m high x 1.6 wide = 2.1 m^2 cross-section

Use 30 L x 2.1 per 100 m row length

= 63 L/100 m row x density factor

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How much is enough?

- Limitations to UCR:
- Subjective estimate of canopy size and density
- No account of interaction between canopy and sprayer
  - assumes worst case 'targeting' of sprays
- 30 L/ UCR is to saturate, not "wet" the vine
  - assumes that "wetting" of all target surfaces is required
- Saturation volumes ARE recommended
  - range from 20 - 50 Litres/UCR
- BUT has been used successfully in a few regions
- Can required dose be achieved by improving spraying efficiency instead?
  - e.g. increasing spray retention & coverage

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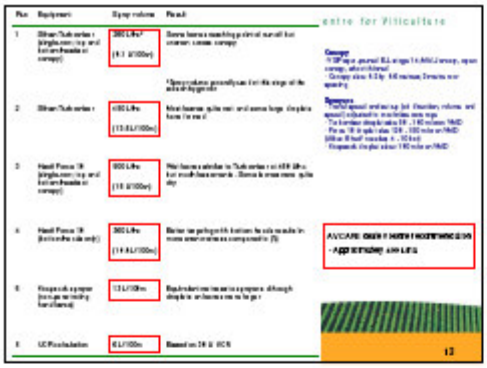
Determining dilute volumes

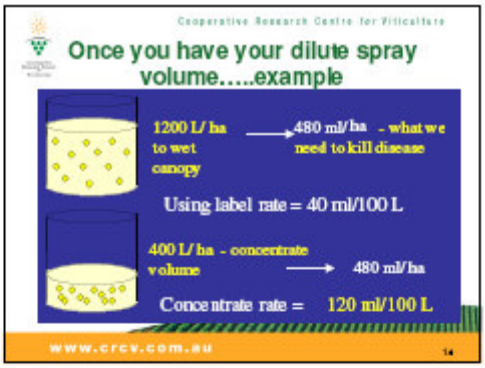
- AVCARE recommendations:
- Based on industry/ researcher/ chemical company experience
- Useful when only using concentrate spraying equipment
- Relatively high volumes on larger canopies
  - compared to industry practice!
- If using lower dilute volumes with consistent results
  - then don't change
- Trial and error approach may be required to determine appropriate volumes
  - use higher volumes within each range for denser canopies
- May consider using in high pressure year OR when spraying to save crop

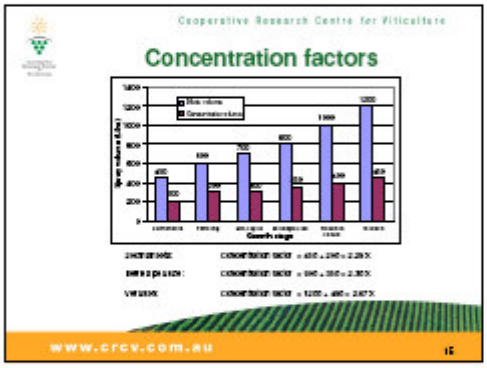
Cooperative Research Centre for Viticulture

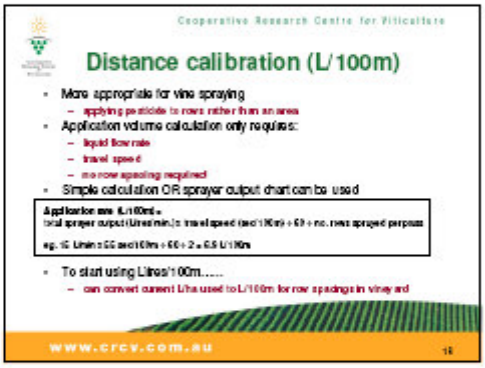
AVCARE recommendations

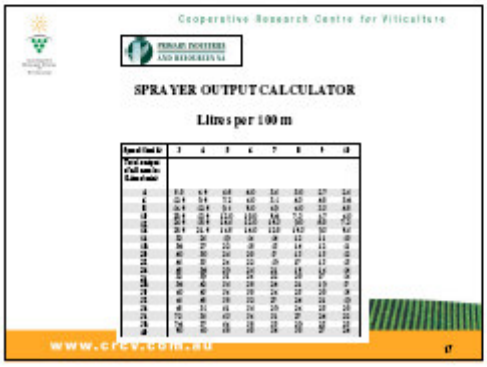


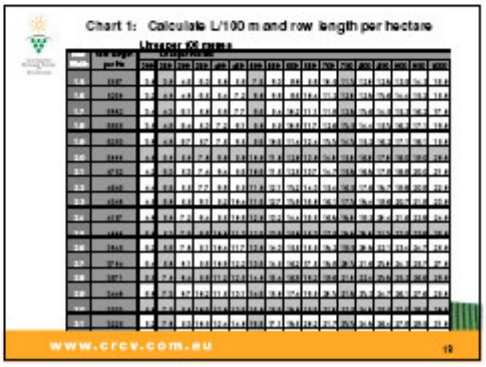

centre for Viticulture


Cooperative Research Centre for Viticulture
Once you have your dilute spray volume.....example
1200 L/ ha to wet canopy
480 ml/ha - what we need to kill disease
Using label rate = 40 ml/100 L
400 L/ ha - concentrate volume
480 ml/ha
Concentrate rate = 120 ml/100 L
www.crcv.com.au
14

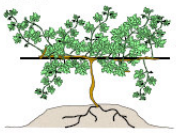

Cooperative Research Centre for Viticulture
Concentration factors
www.crcv.com.au
15


Cooperative Research Centre for Viticulture
Distance calibration (L/100m)
More appropriate for vine spraying
– applying pesticide to rows rather than an area
Application volume calculation only requires:
– liquid flow rate
– travel speed
– no row spacing required
Simple calculation OR sprayer output chart can be used
To start using Litres/100m.....
– can convert current L/ha used to L/100m for row spacings in vineyard
www.crcv.com.au
16


Cooperative Research Centre for Viticulture
SPRAYER OUTPUT CALCULATOR
Litres per 100 m
www.crcv.com.au
17


Chart 1: Calculate L/100 m and row length per hectare
www.crcv.com.au
18

Chemical rate example



1,500 L/ha to 'thoroughly wet' canopy

Chemical dilute label rate = 200 g/100 L



Chemical application rate = 1,500 L/ha x 200 g/100 L = 3,000 g/ha = 3 kg/ha

…..rate we need to give a dose that will kill the disease

1. Chosen concentrate spray volume = 500 L/ha
2. Concentration factor = 1,500 L/ha ÷ 500 L/ha = 3
3. Concentrate chemical rate = 3 x 200 g/100L = 600 g/100 L

Chemical application rate = 500 L/ha X 600 g/100 L = 3,000 g/ha = 3 kg/ha

APPENDIX 4

POWDERY / DOWNY WORKSHOP EVALUATION

1. Did you feel the workshop session was worth while attending?

   ☐ Yes ☐ No

2. What were your expectations for the session?

   1……..

   2. ……..

   3……

   4……

3. Were your expectations satisfied by the session information?

   ☐ Yes ☐ No

4. What new information did you hear in the session?

   1……

   2……..

   3……

   4……..

5. What do you need to know about disease management in winegrapes?

   1……..

   2……..

   3……..

   4……..

APPENDIX 5

Disease importance

Revealed at workshops

Winegrape growers were invited recently to attend one of two detailed disease workshops held in Mildura and Tooleybuc. Participation was high with 90 people attending in Mildura and 30 in Tooleybuc. Topics covered by presenters included the characteristics of powdery and downy mildew, the characteristics and use of "Prosper", "Cabrio", "Peritec" and "Axiom Plus", as well as information relating to spray application and coverage.

Positive feedback

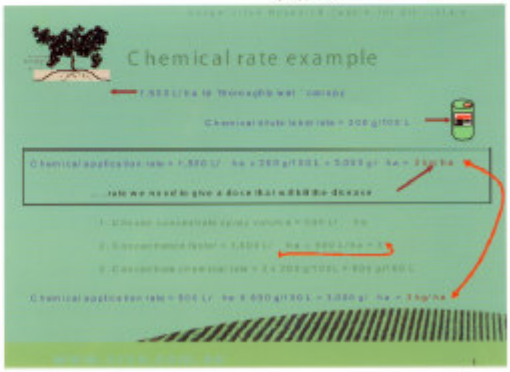
Growers who participated in the workshops indicated that they had heard new information on diseases symptoms and identification, the differences between primary and secondary infection conditions for downy mildew, new information on chemical characteristics and how they could be used in preventative programs, sprayer set-up and calibration, especially regarding dilute versus concentration spraying.

Chemical application rate

Below is the chemical rate example presented by John Lopresti in his presentation of the CRCV Research to Practice Spray application material.

Acknowledgements are made to all speakers and to everyone who helped in the setup and running of the workshops: it was very much appreciated.

As a refresher and a follow up to the disease workshops, a number of smaller sessions are being planned for the beginning of the 2006/07 season to provide information on high and low pressure disease programs, cheaper ways to prevent and control disease, new chemicals and disease symptoms.



APPENDIX 6

Murray Valley Winegrowers Inc
Disease Workshop

Cutting Costs & Maintaining Good Disease Cover In the Coming Season

Rachael McClintock
Consultant IPDM

R&D Viticultural Services
Mobile 0427 000 565

Diseases

- Powdery Mildew



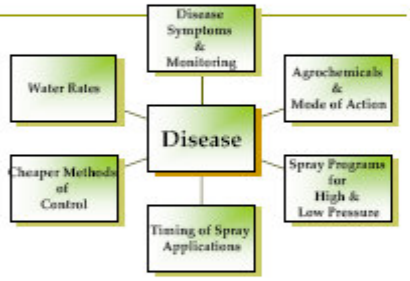
- Downy Mildew



- Botrytis Bunch Rot



View of Topics



Powdery Mildew ('Oidium')



What is Powdery Mildew?



- Also known as 'Oidium'.
- Very common widespread persistent fungal disease well known in the wine industry.
- It is undesirable in winemaking contributing to off-flavours/aromas in wine & can attract $$ deductions or rejection if levels are high.
- Favours mild cloudy/overcast weather and spores are easily spread by wind.

What is Powdery Mildew?





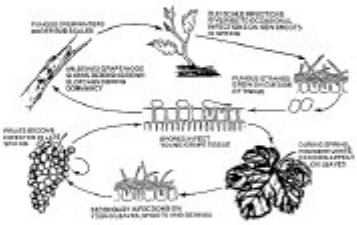
- Fungal disease which survives on all green plant tissue - buds, leaves, shoots, flowers, rachis, berries and canes.
- More likely to occur on previously infected vines, sheltered vineyard sites, dense/shaded canopies & unprotected tissue.
- Powdery Mildew can develop in the absence of free water if relative humidity >40%. No rain is necessary for the disease to sporulate.
- First appearance/signs occur Oct-Nov @ budburst (flagshoots) & commonly at flowering.

What does Powdery Mildew look like?

Active Powdery is 'white ash powder' in appearance with a strong musty odour. Commonly found in dense canopy and on the back of bunches hidden from light, airflow and spray contact.




Disease Life Cycle



Sourced from Nicholas, Magarey & Wachtel, 1995

Lifecycle

- Winter (June - August) – disease dormant in buds from previous season. Also present in vine bark, leaf litter & mummified bunches.
- Spring – (Sept - Nov) 'flag shoots' emerge from infected buds & are start of infection. Shoot growth 5-10cm long. Wind carries spores to neighbouring foliage. 40 days after budburst, spores increase dramatically & severity increases if not controlled effectively.
- Summer – (Dec – Feb) leaves, flowers, berries, bunches infected with spores throughout growing season.

Note – the infection cycle is on-going throughout the growing season and rapidly increases in high disease pressure.

Optimum Conditions & Spread

- Overcast cloudy days, low cloud-cover @ 25°C
- Temperatures >35°C for 12+ hours may denature or kill living spores.
- No rain is required, but high humidity will promote life cycle. However 2.5mm rain above 10°C will encourage further spore release.
- Powdery spores are readily spread during flowering.
- New spores are generated every 5 days in optimum temperature range of 20°-25°C if uncontrolled.

Is Monitoring Necessary?

YES

Lifecycle is very short in conducive conditions & if disease is detected by monitoring the need for spraying can be reduced or eliminated.

Monitoring can also ensure sprays are targeted more effectively at vulnerable growth stages (ie. 10cm shoot, flowering, pea-size berry, veraison)



Hot Spots in the Vineyard

Inspect random vines in areas that are in:

- Low lying areas (hollows)
- Sheltered areas (tree lines, shelter belts)
- Outside rows (possible less spray coverage)
- High vigour – look inside canopy where airflow & sunlight is poor
- White varieties more susceptible – Chardonnay, Semillon, Colombard, Pinot Gris, Chenin Blanc

Dense Canopy

- Powdery Mildew "sleeping giant", high vigour & dense canopy vines → limited air flow, higher humidity in canopy climate, little/no sunlight & poor spray coverage.



Open Canopy

Important to aim for good open canopy, avoid shoot crowding, clean spaces in the crown of the vine.



6 Critical Growth Stages for Application

- Budburst (E-L 7,rosette of leaf tips visible)
- 10cm shoot length (E-L 12, 5 leaves separated)
- 50% Flowering (E-L 23, 17-20 leaves 50% caps off)
- Pea Size Berry (E-L 31, berries 7mm dia.)
- Bunch Closure (E-L 33,berries swelling hard + green)
- Veraison (E-L 35, berries soften, colour change)

Key Spray Practices

- First 20 days from sign of green tissue @ budburst is critical to Powdery Mildew
- Spray weeks 2,4,6 with standard rate 600g/100L of Sulphur for control & prevention
- Early sprays are the MOST effective for the entire season – earlier the better
- Flagshoots develop from previous season, early sprays reduce spore population before flowering

(Peter Margarey, SARDI Plant Pathologist)

Cheaper Control Methods

- Oldest, cheapest & effective control method = Sulphur.
- Rates in Australia are very low (200g/100L) compared to Europe – due to high powdery problems & climate.
- High rates of Sulphur improve control and incidence of disease with a standard rate of 500g/100L or 5kg/Ha.

Wettable Sulphur®

- Group Y fungicide, multi-site activity
- Cheap, conventional, easy applied/mixed in tank
- It has lower hazardous properties to the user
- Acceptable in organic spray programs.

Wettable Sulphur® Con't

- Residues do interfere with winemaking (surpresses yeast activity for fermentation), WHP 30 days before harvest.
- Less effective in cooler conditions (below 17°C) as the vapour action is reduced.
- Sulphur burn may occur when spray >32°C and humid (phytotoxicity)
- Optimum use - maintain spray coverage at least every 12-14 days to ensure new growth is protected from disease in conducive conditions (warm overcast days).
- Unlimited use, no resistance
- Thiovit® & Microthiol®

High Disease Pressure Seasons

- First sign of budburst, a sulphur program should be commenced.
- Higher rates can be used 4-5kg/Ha for the control of mites early season as well – this may reduce any active spore activity that have over-winter in bark & buds.
- In conjunction with Sulphur program, use other groups eg DMI (Bayfidan, Topas), Strobulin (Cabrio, Flint) fungicide etc.

High Disease Pressure Spray Program

12-14 day Sulphur Program up until flowering then :-

- 10% & 50% Flowering – critical for prevention
- Pre-Bunch Closure – critical for prevention





CABRIO FLINT Bayfidan Topas

"Programs including two or three strobilurin applications around flowering were clearly most effective" **– Dr Trevor Wicks - SARDI**

Low Disease Pressure Season

- First sign of budburst, a sulphur program should be commenced.
- Higher rates can be used 4-5kg/Ha (500g/100L) for the control of mites early season as well – this may reduce any active spore activity that have over-winter in bark & buds.
- Spray every 12-14 days with Sulphur product (eg. Microthiol, Thiovit) @ label rates through until 30 days prior to harvest.
- Increase water output rates accordingly to growth stage & canopy development
- This is the cheapest control method.

Active Powdery Mildew

- Trim/prune foliage to allow spray penetration into canopy, airflow, sunlight
- Apply a high water volume to penetrate leaves, bunches
- Double wetting agent
- Choose fungicide carefully (growth stage, WHP, consult winery)
- Spray at least twice 7 days apart
- Apply spray in opposite direction

Water Rate Guideline

- Relative to canopy size, trellis, planting density & type of sprayer
- Air blast sprayer
  - ✓ Budburst 200-300L/Ha
  - ✓ 10cm Shoots 300-400L/Ha
  - ✓ Flowering 500-600L/Ha
  - ✓ Bunch Closure 800-1000L/Ha
  - ✓ Veraison 1200L/Ha
- Aim to penetrate sprays to all green tissue on the vine, evenly & thoroughly.

Post Harvest Sprays – Are they beneficial?

- For young vineyards YES but for older established vineyard the outcome is limited.
- If 'flagshoots' present during the season, infected buds previously established – no real warranty for success.
- Best practice is high rate of Sulphur @ budburst with a saturating spray to wet bark.

Botrytis Bunch Rots



What is Botrytis?



- Fungal disease or grey mould affecting mainly thin skinned grape varieties & very susceptible to tight bunches. Difficult to control due to unusual nature of organism.
- It is a weather & inocolum driven disease which survives in necrotic & dead tissue (mummified berries)
- Undesirable in winemaking, degrades phenolic → loss of colour, flavour & stability in wine.
- Botrytis levels are assessed @ weighbridge with possible $$ penalties.

Favourable Conditions





- **Spores generate between 1-30°C, ideal temp18°C.**
- **High humidity (+96%)**
- **Prolonged rain with cool/mild temperatures (15-20°C for 15-20 hours)**

Favourable Conditions

- **Mild wet spring conditions & rain just before harvest.**
- **Thin skinned varieties & tight bunches (Chardonnay, Semillon, Colombard, Grenache) are very susceptible**
- **LBAM (insect damage), hail, heavy rain, frost & mechanical damage will contribute to fungal infection**

What does Botrytis look like?

Leaves – V-shaped brown area with yellow margin

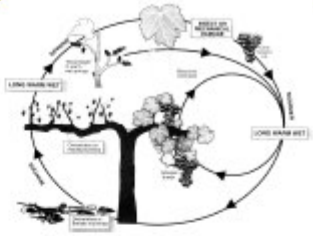
Flowers & Shoots – Patches of soft brown rot on young stems



Bunches – 'slip' skin on soft berries, grey mouldy growth



Disease Life Cycle



Sourced from Nicholas, Magarey & Wachtel, 1995

Life Cycle

- Over-winters in bark & mummified berries
- Wet, moist spring releases spores which travel by air to the vine. Conditions remain wet, early infection in young shoots & flowers
- Prolonged warm wet conditions @ veraison causes 'bunch rot'. Rot spreads and grows from berry to berry within a bunch, releasing spores and infecting other bunches
- Once established very hard to control and suppress easily.

4 Vulnerable Growth Stages Susceptible to Infection

- Early Flowering – flower parts susceptible to infection
- Pre-bunch closure
- Veraison/berry softening
- Harvest

Timing of Fungicides Applications

Growth Stage	Reason
10-20cm Shoot length to Early Flowering	To protect flower. Very critical spray especially if Botrytis present in previous season. This spray will help minimise risk of infection.
80% Flowering	Sprays eradicate any latent infection in flower parts & protect against further spread.
Pre-bunch Closure	Last Chance to reduce infection from inside the bunch & protect bunch from infected flowers not properly developed into berries. Critical Spray.
Veraison to Pre-harvest	Maybe needed if berries damaged (LBAM) or wet rain period close to harvest.

Botrytis Fungicide's

Fungicide Group	Agrochemical	WHP
Group Y (multi site activity)	Captan	No later than 30 days prior to harvest
Group A	Spin Flo	Before bunch closure
Group B	Rovral Sumisclex	No later than 7 & 9 days
Group I	Scala	No later than 80% capfall

- Do not apply more than 2 consecutive sprays from the same group, including from the end of one season to the next.
- If Botrytis levels are high (20%) in bunches late season sprays may not be successful.

Cultural Practices

- ~~Prevention is better than cure. Use preventative sprays early season. Remove bunches from previous season.~~
- Keep LBAM populations low, look for webbing & larvae early season
- Encourage good open canopy to generate airflow for evaporation of moisture & to maximise spray coverage
- Avoid harsh trimming, sunburn & berry splitting increases wound sites for infection
- Be vigilant with N fertilisers → high vigour, shading & dense canopies
- Keep mid-rows neat, avoid high cover crops & weeds → humidity especially with low throw sprinklers

Irrigate on Warm Windy days with Over-head Irrigation



Avoid Mid-rows like this



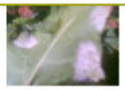
PMS – Potassium Metabisulphite

- PMS is a legal additive during winemaking process but is NOT REGISTERED for use in vineyards (ie its use in the vineyard is illegal).
- However, if you do consider applying PMS it is essential that you contact the purchaser of your fruit and/or the relevant winery.
- Evidence to date regarding the effectiveness of PMS as a *Botrytis* control agent is contradictory and largely anecdotal.
- However, in a recent study PMS does appear to have some antifungal activity on existing *Botrytis* infected fruit but this activity is very short lived and does not prevent further sporulation (Wicks *et al*, 2002).
- All information sourced from Dr Sally-Jean Bell, AWRI

Downy Mildew



What is Downy Mildew?



- A detrimental fungal disease spread by rain which will defoliate a vine & has 2 infection cycles.
- Fungal disease which survives on all green plant tissue - leaves, shoots, flowers & rachis.
- Over-winters in the vineyard floor as 'oospores' & can be easily transferred to the vine in mild wet condition by 'rain splash'.
- Requires careful monitoring in conducive conditions

Primary & Secondary Infection

- Primary Infection

Yellow oil spots develop on topside of leaf, which grow rapidly & kill off green cells/tissue

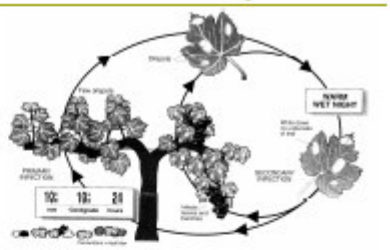


- Secondary Infection

'White down' on the underside of leaf below oil spot



Disease Life Cycle



Sourced from Nicholas, Magarey & Wachtel, 1995

Optimum Conditions & Spread

- 10:10:24 (rule of thumb)
- 10ml rain @ 10°C for 24 hours to establish 'primary' infection
- Secondary infection occurs when:
  - → Primary infection has occurred
  - → Viable oil spots survive in vineyard
  - → After a warm wet night (min 13°C)
  - → Leaves remain wet at dawn
- Rapid spread if uncontrolled
- Need a primary infection (oils spot) to generate secondary infection (white downy growth)



Primary Lifecycle

- Spores (oospores) over-winter in leaf litter on vineyard floor
- In 10:10:24 'rain splash' transfer spores from soil → foliage In the next 2-3 hrs infection occurs.
- Oil spots develop on healthy green tissue (leaves) quickly between 20-25°C... the disease begins. Initial infection is low, appear 5-15 days after rain event.
- As spot gets older darkens in colours with 'oily' appearance

Oil Spot Sprayed Out



Secondary Lifecycle

- Spores develop on warm humid nights:
  - 98% humidity
  - Min 13°C
  - 4 hours darkness (night)
  - Leaves wet 2-3 hrs pre-dawn
  - Spores easily transported by wind



Is Monitoring Necessary?

YES

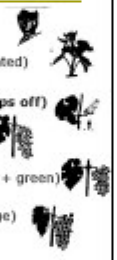
- Definitely examine blocks with no spray coverage in past 14 days
- Look in wet shelter areas of the vineyard
- Dense shaded canopies
- Examine low-lying foliage close to the ground
- Blocks if previously infected

Bag Test – Simple & Effective

- Collect suspect leaves with possible oil spots
- Incubate in sealed plastic bag with moist tissue in dark warm place (20-25°C)
- Check next morning for fresh white down.

ALL Growth Stages are vulnerable to Downy Mildew Infection

- Budburst (E-L 7,rosette of leaf tips visible)
- 10cm shoot length (E-L 12, 5 leaves separated)
- **Flowering (E-L 23, 17-20 leaves 50% caps off)**
- Pea Size Berry (E-L 31, berries 7mm dia.)
- Bunch Closure (E-L 33,berries swelling hard + green)
- Veraison (E-L 35, berries soften, colour change)



Pre-Infection Sprays

- Prevents oil spots from occurring
- Apply sprays as close to rain event as possible

Fungicide Group	Agrochemical	WHP
Group Y (multi-site activity)	Copper Based Products (Coppox, Kocide, Blue Shield) Mancozeb based Products (Dithane, Manczeb)	No later than 30 days prior to harvest
Group K	Cabcio (Downy & Powdery Mildew)	Before bunch closure

Post Infection Sprays

- Prevents oil spots from developing further
- Fungicides needs to applied 4-5 days of infection
- Only 2 chemical groups available for post infection sprays
- Phosphoric Acid groups are no longer registered for use in export wine.
- Ridomil has become resistance (Hunter Valley) due to over-use in Australia so care needs to be taken

Fungicide Group	Agrochemical	WHP
Group D + Y	Ridomil Axiom	No later than 30 days prior to harvest
Group X	Acrobat	No later than 80% capfall

Prevention is Can Be $Cheaper

- Copper & Mancozeb products are excellent preventative cover sprays for Downy Mildew
- Easily incorporated with 14 day Sulphur program
- Compatible with Sulphur
- Low cost, warranted in high rainfall disease season.
- Many growers pay the price of no copper sprays → post infection spray of Ridomil which is $$$.
- Little result with Copper/Mancozeb after oil spots have developed so important to apply sprays before rain event.

Summary

- First 20 days are critical from first sign of green tissue, apply Sulphur 600g/100L @ weeks 2,4,6 for optimum control through until flowering
- Maintain regular consistent 14 day cover sprays for both protection against Powdery & Downy Mildew
- 3 Sulphur cover sprays prior to flowering reduce spores & prevent rate of infection, early sprays are the cheapest measure in the long run

Disease Control Failures

- Lack of monitoring or inspection
- Spray interval too long (14-21 days)
- Initiation of sprays too late – spores established
- Wrong product & rates used

Disease Control Failures

- Spray machines not calibrated
- Poor coverage – drive too fast, blocked nozzles
- Low water rate for canopy size
- Too many chemicals in the tank - dilution

Tips during the Growing Season

- Pay attention to long range weather forecast, listen for rain events, humidity, cloudy days
- Be vigilant with cover spray programs, tighten spray days 10-12 days for good protection if need be
- Check chemical stocks
- Monitor vineyard regularly for the early signs

Tips during the Growing Season

- Keep mid rows tidy, excess weeds/high grass will promote humidity for disease
- Talk to other growers in your area, use your winery GLO for advice
- Avoid long holidays to QLD for Christmas with the family! Who will spray when you are away??

Take Home Message – 3 Important T's

- Timing of sprays - the key to control
- Treatment – which product
- Technique - how it is applied effectively



disclaimer

- Always read and follow label directions to ensure the best results in the vineyard.
- R & D Viticultural services provides the information contained within this presentation in good faith and does not guarantee accuracy.

Acknowledgements

- Murray Valley Winegrowers Inc.
- Landmark
- Nufarm
- Dr Trevor Wicks & Dr Barbara Hall (SARDI)
- Russell Johnstone (Orlando Wyndham)
- Peter Margarey, Plant Pathologist SARDI
- AWRI, Dr Sally-Jean Bell

Thank you & all the best for the 2006/07 growing season



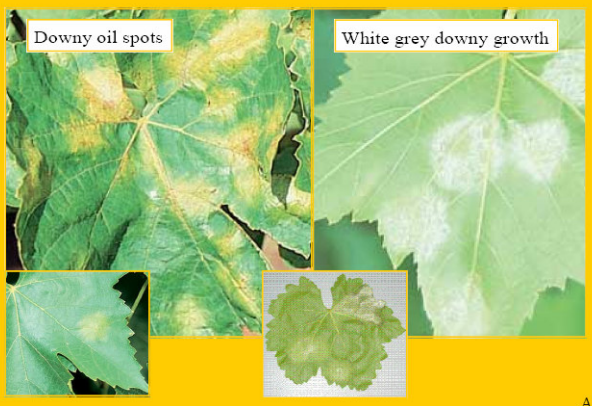
APPENDIX 7

VINEYARD DISEASES

POWDERY MILDEW



DOWNY MILDEW



BOTRYTIS



All photo material provided by R. McClintock, J.Vardanega, E.McGuire & P. Magarey

Murray Valley Winegrowers' Inc

R&D Viticultural Services
Mobile 0427 000 565

APPENDIX 8

Disease Workshops

Prepare growers

Liz McGuire
Industry Development Officer

Five disease workshops were held recently to prepare growers for the coming season.

The workshop information was presented by new Murray Valley pest & disease consultant Rachael McClintock and workshops were supported by Landmark, NuFarm, Bayer CropScience and Dow AgroScience.

Important information highlighted in the workshops included:

Powdery Mildew:

- The first 20 days from the sign of green tissue are critical to prevent the outbreak of powdery in the vineyard.
- Under favourable conditions at a temperature of 27ºC the powdery lifecycle can be as short as 5 days, meaning it can spread very quickly.
- Flowering and pre-bunch closure are critical application timings for prevention.

Botrytis:

- Mummified berries left on the vine during dormancy are a critical source of botrytis infection and should be removed.
- Controlling LBAM can assist in decreasing the opportunity for botrytis to infect the vineyard.
- Flowering, pre-bunch closure and veraison are critical application timings for prevention.

Downy:

- 10:10:24 is a rule of thumb only. Downy can develop under conditions of less rain, less time and various temperatures.
- All growth stages are vulnerable to Downy Mildew infection.
- Use the simple bag test when monitoring for disease to confirm infection.

More than 70 people participated in the workshops with 51 filling out the evaluation form. Results from the evaluation indicated that 100% of participants thought the workshop was worthwhile and that expectations were satisfied by the information presented. Some comments made on the day indicated that participants heard new information on the implications of having too many chemicals in the tank mix, the effects of temperature and humidity on spray effectiveness and vine damage, the use of cultural practices to decrease disease, importance of a wetting agent and the critical timing of prevention sprays.

Of particular interest were spray programs to combat high and low disease pressures, and one that could be used in a year of little or no income from grape production. These programs were displayed and discussed during the workshop and gave participants a good indication of which chemicals were best at which time throughout the season to prevent disease. Unfortunately, due to legality issues, these programs cannot be distributed, but if you would like to discuss disease programs for the coming season please contact Rachael McClintock on 0427 000 565.

Important Note from Rachael: please note the high rate of wettable Sulphur is 500g/100L NOT 600g/100L as listed in the handout. Always read and follow label instructions before using any chemical.

If you were not able to attend the workshop but would like the handouts or one of the disease posters shown below, please contact Liz McGuire on (03) 5021 3911.



