Tasmania
DEPARTMENT of PRIMARY INDUSTRIES, WATER and ENVIRONMENT

Vineyards Association of Tasmania

Australian Government
Grape and Wine Research and Development Corporation

Spray Application Field Day Tasmania



FINAL REPORT to
GRAPE AND WINE RESEARCH & DEVELOPMENT CORPORATION

Project Number: **RT 05/04-2**

Principal Investigator: **Duncan Farquhar**

Research Organisation: **Vineyards Association of Tasmania**

Date: **9th February 2006**

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VINEYARDS ASSOCIATION OF TASMANIA

ANNUAL FIELD DAY

SPRAY APPLICATION

Richmond Village Hall and Domaine A Stoney Vineyard

Thursday 10th November 2005

9.30am at Richmond Village Hall

Program:

9.30am	Registration and Coffee
10am to 1pm	**Understanding the importance of spray applications, how to manage them, how to use new technologies and how to ensure their effectiveness and safety.** Speakers: **Ray Guerin**, Cool climate viticulturist with Hardy Wine Company in Victoria **John Kent**, Senior Lecturer in Agricultural Protection at Charles Sturt University **Allison McGregor**, Department of Primary Industries, Mildura, Victoria **David Manktelow** Consultant previously with Horticulture Research, New Zealand
1.15pm	**Domaine A Stoney Vineyard**
1.15 - 2.00pm	Barbecue Lunch and Trade Displays
2.00 – 3.00pm	Trade presentations including practical demonstrations
3.00pm – 4.30pm	Panel discussion
Cost:	The cost of the Field Day will be $30 for VAT members and $60 for non-members. Cost includes lunch and morning coffee

Registration to Di McArthur Ph: 6334 9721 or email vat@branchoffice.com.au by 4th November

Financial support for the Field Day has been provided by the Grape and Wine Research and Development Corporation

The VAT Field days have a checklist to asssist organisers to manage the day. This is included below.

Field day Check List

Speaker identification

From Technical committee
From industry feedback
From research community
Develop running sheet with timings

Speakers Briefed

Who is Chairman
Handouts to be printed and copied
To the point
Try to avoid commercial bias

Advertise

Tas Country
VAT Newsletter
Web
Country hour

Powerpoint and presentation facilities

Projector
Screen
Dark enough – triple check this one
Overhead projector

Lunch

Sufficient
Coffee
Water
Wine Glasses and appropriate format for tasting.
Consider comfort of people attending especially what is to be presented during the after lunch nap!

Consideration of trade as stakeholders

Format and space for exhibitors. Include exhibitors relevant to topics and others.
Pre lunch opportunity for trade spruke – strict 3 minutes
Early notification of date
Set time for trade demonstrations

Conduct of the Day

Gift and thankyou for speakers
Finish with a bang, not drifting off.
Parking
Panel argument to be hi energy and productive

Social Program for speakers

Dinner the evening before/after
Venues
Topics
Guests

Debrief

Speaker quality
This checklist
Additions to this checklist
Next field day and events

Ray Guerin

Started life in McLaren Vale, SA where his grandfather, father and uncle were fruit and winegrape producers. This was his early introduction to the wine industry that became his life.

He bought and managed his own vineyard in Blewitt Springs from 1971 through to 1986 when a offer came to develop a cool climate vineyard in the Yarra Valley (Hoddles Creek Vineyard). The plan was to set up the vineyard over a three year period and move back to McLaren Vale.

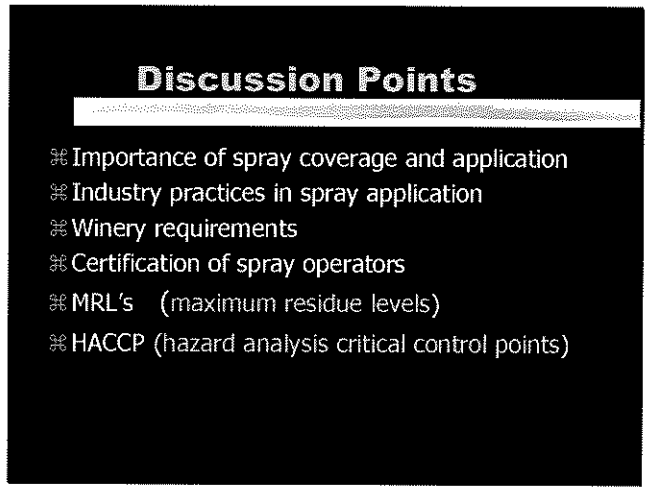
The challenge of cool climate viticulture in the beautiful Yarra Valley attracted him to the point where he sold his vineyard interest in SA. Over the next two years Yalumba and Thomas Hardy and sons became shareholders in the Hoddles Creek Vineyard development to secure a supply of fruit for sparkling wine production. Then in 1993 the newly developed BRL Hardy Wine Co. from the merger of Berri Renmano and Thomas Hardy & Sons bought out all shareholders including Ray.

In 1994 as a employee of BRL Hardy he was asked to be involved in company vineyard developments and contract fruit supply in the ACT (Canberra) Tumbarumba, Tasmania and Victoria. The early days in Tasmania were with Ed Carr, Hardy's very successful sparkling winemaker. It was a period of discovery to find the true potential that Tasmania had to offer. Initially buying small parcels of fruit from growers far and wide has allowed the Hardy Company to obtain a good understanding of Tasmanian regional variation and product potential. The company now produces a very pleasing range of wines under the Bay Of Fires label topped by the premium Arras sparkling wine.

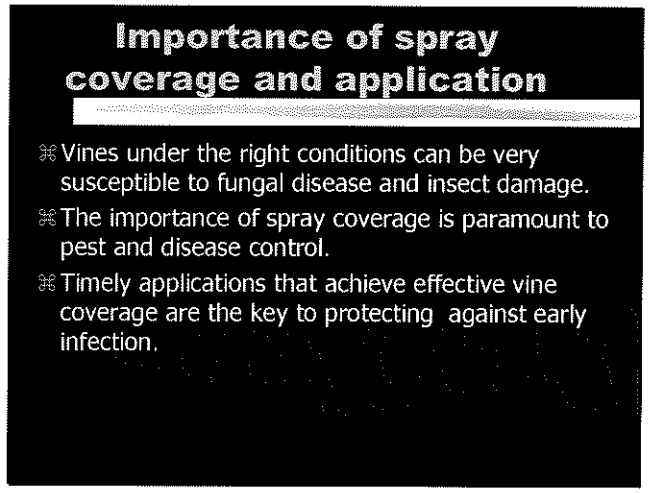
Slide 1



Slide 2



Slide 3



Slide 4

Importance of spray coverage and application

- Question : How effective is your spray machine.
- To the grower spraying is a necessary evil.
- Winery expectations are high when it come to fruit quality. Most happy to accept clean pest and disease free fruit.

Slide 5

Industry practices in spray application

- Many machinery options and methods of application available for vineyard use.
- High air volume/low pump pressure, low to medium air/high pump pressure, hydraulic or electrically driven axial fans.
- A choice of high or low water volume.
- Low volume spraying is widely accepted and practiced in cool climate viticulture.

Slide 6

Industry practice in spray application

- Single or double row spraying.
- Consider spray machinery to suit trellis design (VSP,Scott Henry,Lyre).
- Consider row width and spray head distance from the canopy.
- Consider the environment and neighbour.

Slide 7

Winery requirements

- To receive high quality fruit at the winery door " *free from pest & disease*
- To know what chemicals were applied throughout the year and rates.
- Need to see a record of spray equipment calibration.
- Chemical residue should not exceed industry set MRL's.

Slide 8

Certification of spray operators

- All Tasmanian vineyard owners should consider having a person who has completed the Chemcert chemical users coarse prior to spraying a vineyard.
- These coarse are available through TAFE.
- The employer is responsible for ensuring that the operator has an adequate understanding of spray calibration, application, chemicals, safety and risk associated.

Slide 9

MRL's

Maximum Residue Levels

- These are Australian or the Export Maximum Residue Level - acceptable in wine, that are not to be exceeded.
- What are we doing to monitor and meet this requirement. Education and training of company growers as well as random monitoring of fruit intake at the winery.

Slide 10

HACCP

Hazard Analysis and Critical Control Points

- The HACCP food safety system is designed to identify monitor and control risks to food safety.
- The purpose of this plan is to ensure:
- 1. Food safety for human consumption.
- 2. Wine grapes will meet customer specifications relating to food safety.
- Key areas of the HACCP process - chemical storage, chemical inventory, Spray diary, spray calibration, record keeping and auditing.
- HACCP certification is a requirement by a number of major wine companies prior to fruit purchase.

Slide 11

CONCLUSION

- Spray application is so important in pest & disease.
- Timing and effective coverage is the key to success.
- Correct selection of a spray unit to suit your trellis and site can make a difference.
- Clean fruit at the winery door is the essential ingredient to final wine quality.
- Purchasing wineries insist on clean fruit.

Mr John Kent

John Kent is Senior Lecturer in Agricultural Protection and Acting Head of the School of Agricultural and Veterinary Sciences of Charles Sturt University, Wagga Wagga, NSW. He is also Joint Leader of the Extension, Education and Communication Program of the E. H. Graham Centre for Agricultural Innovation, a collaborative initiative of Charles Sturt University and NSW DPI.

Mr Kent has over 30 years experience in agricultural education both in Australia and overseas with special expertise in the correct use of farm chemicals as part of integrated pest management programs, and in weed management. As well as undergraduate teaching in Agriculture, Environmental Horticulture and Viticulture, he has responsibility for post graduate supervision at Honours, Master and PhD levels. His research and consultancy expertise includes best practice pesticide management and the development and implementation of a range of industry training programs including a heavy involvement in the development and operation of the ChemCert Farm Chemical User Training Program in NSW and nationally, and a range of specialist modules including *Spray Application in Vineyards*. He is author of a range of books, book chapters and papers on best practice pesticide management, including *Spray Application in Vineyards*, and has presented at numerous industry workshops, conferences and training days.

Contact details

John Kent
Senior Lecturer in Agricultural Protection
Acting Head: School of Agricultural and Veterinary Sciences
Charles Sturt University
Locked Bag 588
WAGGA WAGGA, NSW 2678

Ph 02 6933 2489
Fx 02 6933 2812
jhkent@csu.edu.au

Vineyards Association of Tasmania

Spraying grapevines

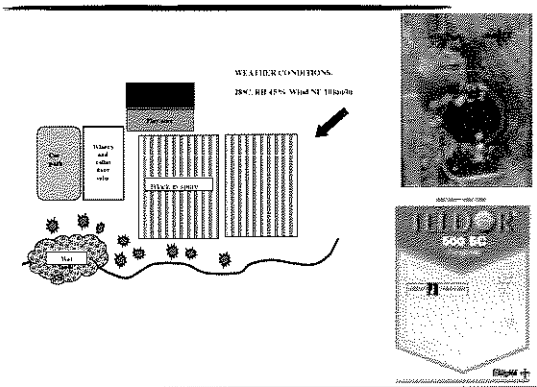
CHARLES STURT UNIVERSITY

John Kent
Senior Lecturer in Agricultural Protection
School of Agricultural & Veterinary Sciences
E.H. Graham Centre for Agricultural Innovation
Charles Sturt University, Wagga Wagga, NSW

How do we best apply the pesticide to the target?

- Principles of application
- Spray droplet behaviour
- Adjusting and calibrating mistblowers
- Calibration & calculating spray mixes

How do we do this best?



Our challenges!

- Good results! – cost effective control
- Maximise benefits of pesticides
- Minimise potential adverse effects
- Scrutiny of practices by community, customers and regulators
- Legal obligations:
  - **Occupational health and safety**
  - **Risk management**
  - **Food safety and Residue management (MRL's)**
  - **Environmental protection**
- Resistance

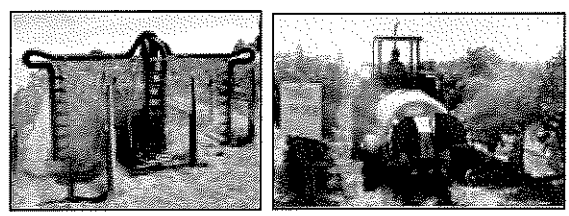
Implement best practice

- All stages of pesticide management chain

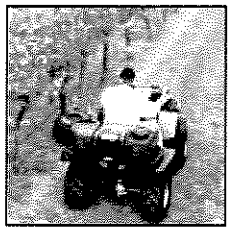
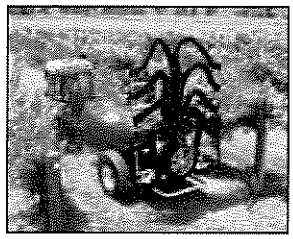
Product selection
Purchase
Transport
Handling, and storage
Application
Clean up
Waste disposal
Record keeping

Spray application of pesticides

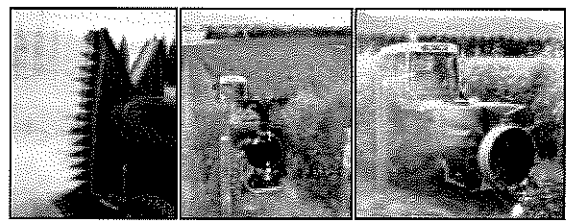
- Spraying is inefficient
- Efficiency and results can be improved with correct set up



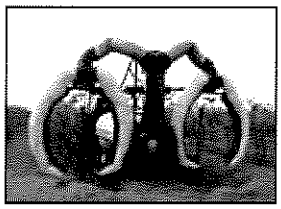
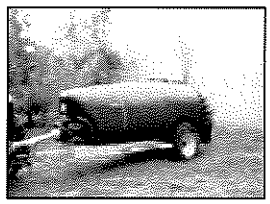
- Set up, adjustment & calibration is more important than type of sprayer
- Understand application principles
- Adopt good technology
- Select most appropriate equipment

- Adjust equipment for selected pesticide, target and conditions
- Calibrate equipment to apply label rate
- Ensure correct timing of application



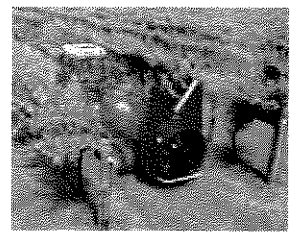
- Minimise losses - *runoff, missing target, drift*
- Decontaminate:
  - application and handling equipment
  - operator
- Monitor results

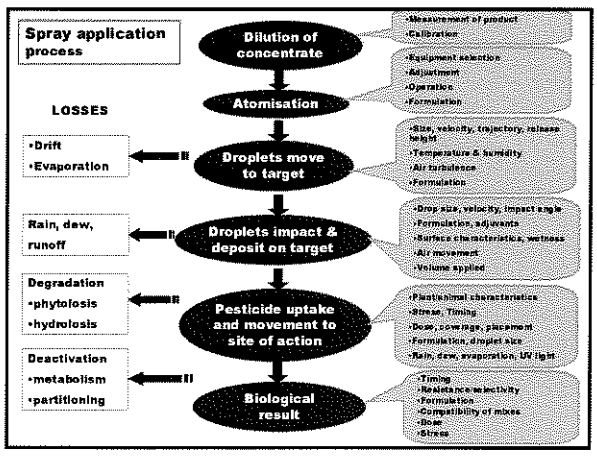



Improving results - adjustment & calibration

Three keys:

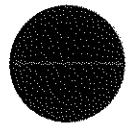
1. Understand spraying process and how spray droplets behave
2. Get coverage right
3. Get dose right





Spray droplets

Droplet size... diameter



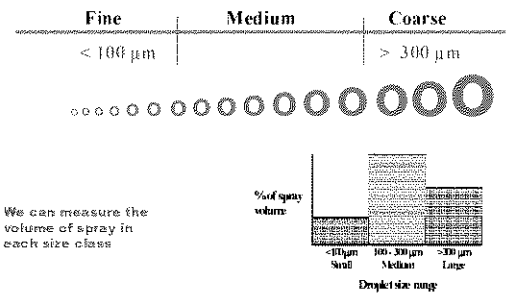
1,000 microns (µm) = 1 mm

Sprayers produce a range of droplet sizes ...

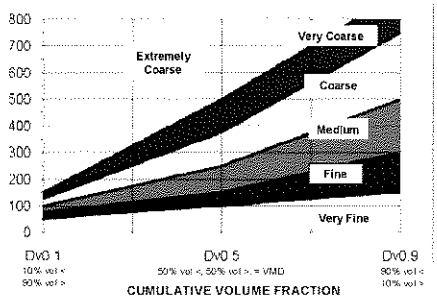
the *droplet spectrum* or *spray quality*

for example ....

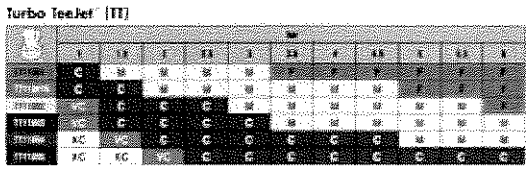
Practical size classes



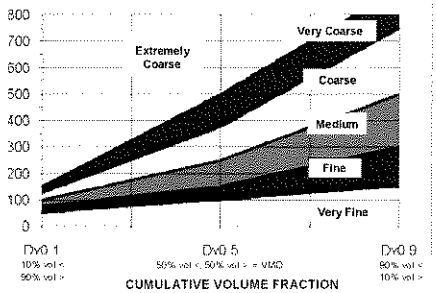
BCPC/ASAE spray quality classes



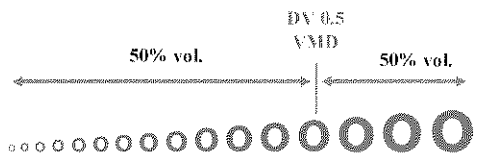
Nozzle charts and spray quality



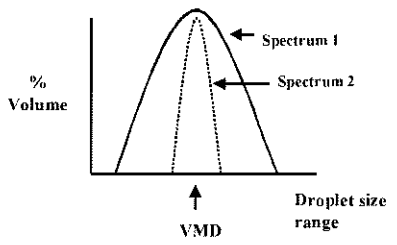
BCPC/ASAE spray quality classes



DV 0.5 - Volume Median Diameter



Two different sprays - same VMD



How to change droplet spectrum?

	Droplet Size		
	Fine	Medium	Coarse
Hydraulic			
Nozzle size	*small*		*large*
Pressure	*high*		*low*
CDA			
Rotation speed	*fast*		*slow*
Flow rate	*low*		*high*
Airshear			
Air speed	*fast*		*slow*
Flow rate	*low*		*high*

How do droplets behave?

- Depends on size
- Size determines:
  - **Trajectory in air**
  - **Drift potential**
  - **Evaporation potential**
  - **Deposition efficiency**
  - **Coverage of target**
  - **Biological efficacy**
    - *For example*

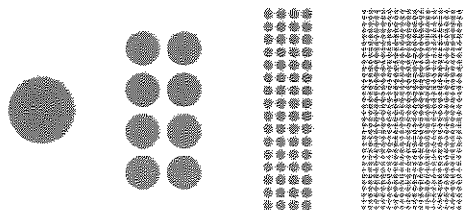
Characteristics of droplets

	Size		
	Fine < 100µm	Medium 100 - 300µm	Coarse > 300µm
Momentum	*low*	⟷	*high*
Evaporation risk	*high*	⟷	*low*
Coverage per volume	*high*	⟷	*low*
Gravity effect	*low*	⟷	*high*
Canopy penetration	*high*	⟷	*low*
Risk of drift	*high*	⟷	*low*

Droplet movement in a canopy



Coverage & droplet size

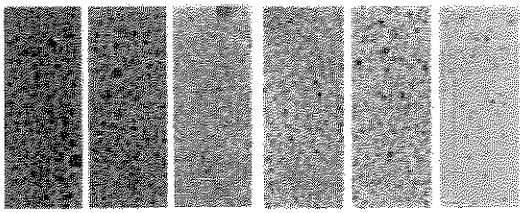


1x 400µm = 8 x 200 µm = 64 x 100 µm = 512 x 50 µm

Source: TeeJet

Coverage

Deposits on water sensitive paper



runoff | Ideal coverage | Insufficient coverage

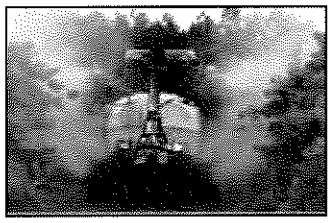
How do we improve coverage?

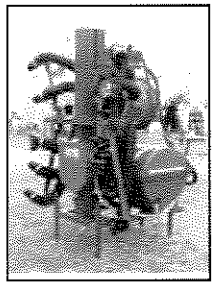
1. Increase spray volume
   - **Match to target, chemical and equipment**
   - **Take care with runoff (wastage)**

2. Get the droplet size right

How do we improve coverage?

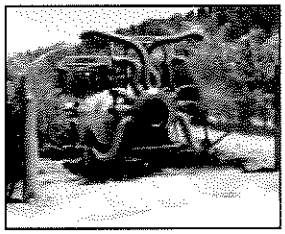
3. Air assistance



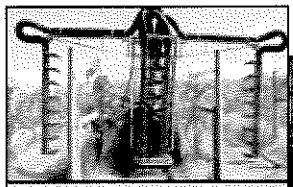


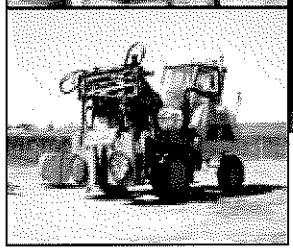
How do we improve coverage?

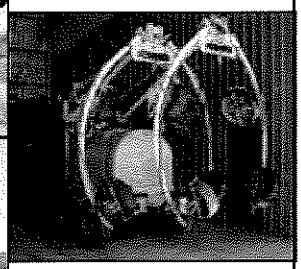
4. Direct air & spray to target











How do we improve coverage?

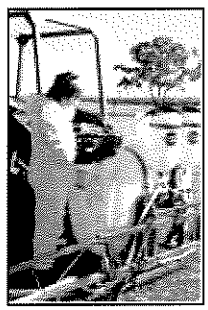
5. Improve retention of droplets on target

Influenced by:

- **volume of spray applied**
- **wetness of leaf**
- **rain, dew, irrigation after spraying**
- **characteristics of target surface**
- **angle droplets strike surface**
- **spray adjuvants**
- **size of droplets**

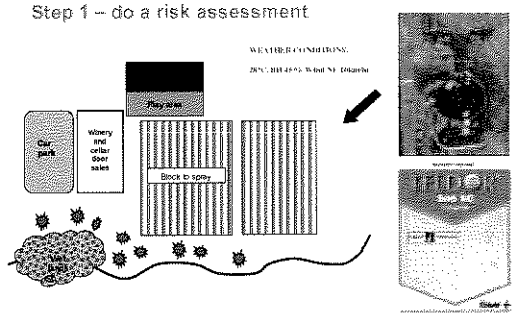
How do we get the dose right?

- Following label directions
- Calibration of equipment
- Correct mixing
- Operation of equipment



Steps to adjusting mistblowers

Step 1 – do a risk assessment



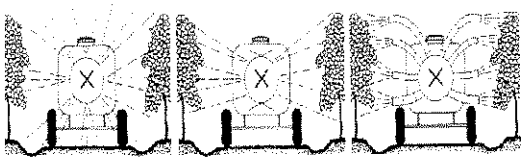
Adjusting mistblowers

Step 2 – make sure it is operating correctly



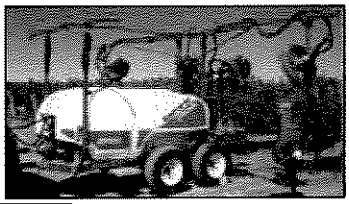
Step 3 – direct air to canopy

Converging air is better than diverging air



✗ ✓ ✓

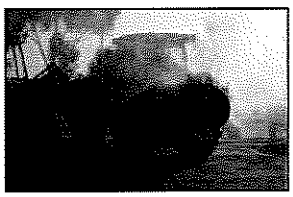
Converging air

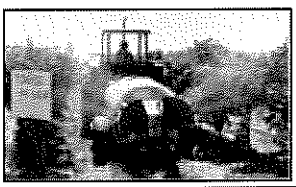




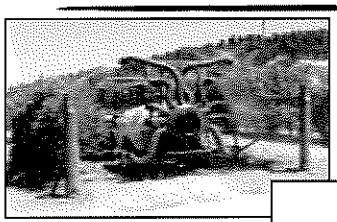
Poorly directed air

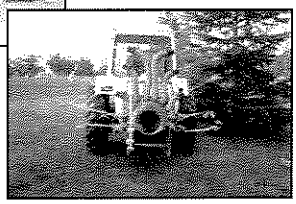






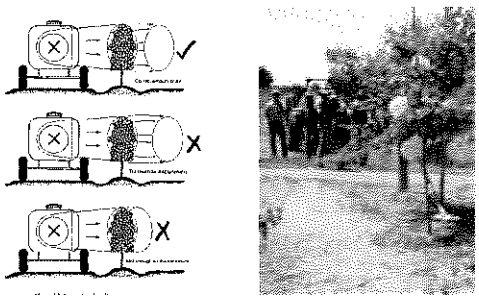
Use ribbons to help adjust air





Step 4 - adjust quantity of air

- Air should penetrate to far side of canopy
  - **Use ribbons or balloons to show air volume**



How to adjust quantity of air

- The greater the volume of air and the faster the air the further it will penetrate
- Adjust air by:
  - **fan speed or blade angle**
  - **tractor speed**
- The slower the forward speed the more it will penetrate
- Balance air volume and air velocity
  - **Avoid shingling**

Step 5 - Select right droplet size

- Aim for fine sprays to get good coverage
  - **Nozzle type**
  - **Nozzle size**
  - **Spray pressure**
- E.g. fine nozzles and high pressures
  - **Ensure pressure is within specs for nozzle**



Step 6 - Adjust spray volume

- Increase volume as canopy grows
- Volume applied depends on sprayer
  - **Dilute sprayer – spray to point of runoff**
  - **Concentrate sprayer – less than runoff**
  - **Calibrate so amount of chemical applied is the same**

INDICATIVE WATER VOLUMES AS A GUIDE FOR DILUTE SPRAYING GRAPEVINES

SPRAWL CANOPY	Up to 0.5x0.5 m	Up to 1x1 m	Up to 1.5x1.5 m	Up to 2x2 m and above
Indicative volume L/100 m	10 to 20	20 to 40	45 to 60	60 to 90
Indicative volume L/ha (for 3 m row spacing*)	300 to 650	650 to 1,300	1,500 to 2,000	2,000 to 3,000

VSP CANOPY	Up to 0.5x0.5	Up to 1x1 m	"Wires up" stage, up to 1.5x0.5 m	Up to 2x0.5
Indicative volume L/100 m	10 to 20	20 to 40	30 to 55	45 to 75
Indicative volume L/ha (for 3 m row spacing*)	300 to 650	650 to 1,300	1,000 to 1,800	1,500 to 2,500

Increase spray volume by:

- Using more fine nozzles – not bigger nozzles
- Driving slower

Step 7 – Calibrate to get dose right

- Essential to apply correct dose & label rate
- Labels give **dilute** spray rate e.g. 1 kg /100 L
  - **i.e. rate if spraying to point of run off**
- If spraying to *less* than run off (**concentrate spraying**) must adjust spray mix.

GENERAL INSTRUCTIONS:
Before opening, carefully read Directions For Use, Precautionary Statements, Safety Directions and First Aid Instructions.

MIXING/APPLICATION: For tree & vine crops only

Dilute Spraying
Use a sprayer designed to apply high volumes of water up to the point of run-off and matched to the crop being sprayed. Set up and operate the sprayer to achieve even coverage throughout the crop canopy. Apply sufficient water to cover the crop to the point of run-off. The required water volume may be determined by applying different test volumes, using different settings on the sprayer, from industry guidelines or expert advice. Add the amount of product specified in the Directions for Use table for each 100L of water. Spray to the point of run-off. The required dilute spray volume will change and the sprayer set up and operation may also need to be changed, as the crop grows.

Concentrate Spraying
Use a sprayer designed and set up for concentrate spraying (that is a sprayer which applies water volumes less than those required to reach the point of run-off) and matched to the crop being sprayed. Set up and operate the sprayer to achieve even coverage throughout the crop canopy using your chosen water volume. Determine an appropriate dilute spray volume (See Dilute Spraying above) for the crop canopy. This is needed to calculate the concentrate mixing rate. The mixing rate for concentrate spraying can then be calculated in the following way:

Example only:
1. Dilute spray volume as determined above: For example 1500L/ha
2. Your chosen concentrate spray volume: For example 500L/ha
3. The concentration factor in this example is: 3 x (ie. 1500L ÷ 500L=3)
4. If the dilute label rate is 10mL/100L, then the concentrate rate becomes 3 x 10, that is 30mL/100L of concentrate spray.

The chosen spray volume, amount of product per 100L of water, and the sprayer set up and operation may need to be changed as the crop grows. For further information on concentrate spraying, users are advised to consult relevant industry guidelines, undertake appropriate competency training and follow industry Best Practices. For concentrate application- do not use a concentrate spray rate greater than 5 times the dilute spraying rate.

Concentration Factor

- Must increase concentration of spray mix if concentrate spraying

1. **Estimate dilute spray volume/ha or per 100 m**
2. **Calibrate sprayer to measure actual (concentrate) spray volume/ha or 100 m**
3. **Dilute vol ÷ Actual vol = concentration factor (CF)**
4. **Dilute chemical rate x CF = rate to use**

INDICATIVE WATER VOLUMES AS A GUIDE FOR DILUTE SPRAYING GRAPEVINES

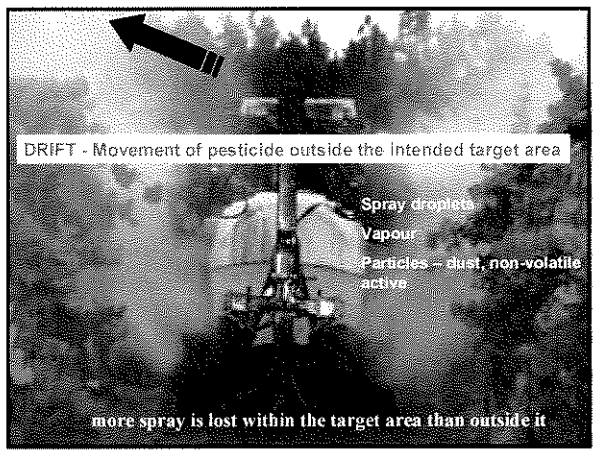
SPRAWL CANOPY	Up to 0.5x0.5 m	Up to 1x1 m	Up to 1.5x1.5 m	Up to 2x2 m and above
Indicative volume L/100 m	10 to 20	20 to 40	45 to 60	60 to 90
Indicative volume L/ha (for 3 m row spacing*)	300 to 650	650 to 1,300	1,500 to 2,000	2,000 to 3,000
VSP CANOPY	Up to 0.5x0.5	Up to 1x1 m	"Wires up" stage, up to 1.5x0.5 m	Up to 2x0.5
Indicative volume L/100 m	10 to 20	20 to 40	30 to 55	45 to 75
Indicative volume L/ha (for 3 m row spacing*)	300 to 650	650 to 1,300	1,000 to 1,800	1,500 to 2,500

For example …

- Label:
  Dilute spraying rate: mix 1 kg/100 L of water
- For a 1 m x 1 m medium density canopy
  - **Recommended dilute spray vol = ~ 1,000 L/ha or 30 L/100m**
  - **Your measured spray vol = 500 L/ha or 15 L/100m**
  - **Then CF = 1,000 ÷ 500 (30 ÷ 15) = 2**
  - **spray rate/100 L to mix = 1 kg x CF 2 = 2 kg/100 L**

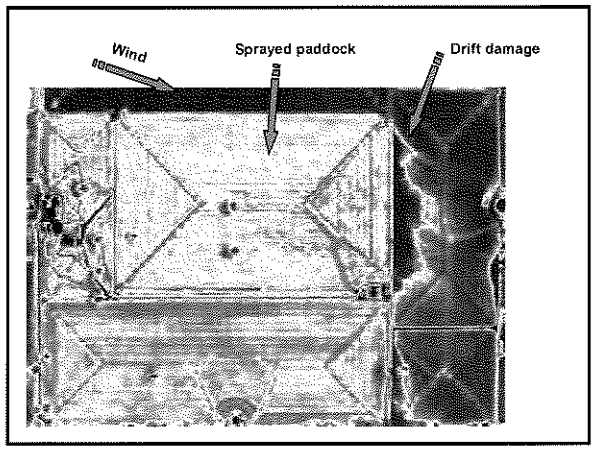
Managing Pesticide Drift

- Problems
- Causes
- How to manage



Potential problems caused by drift

- Damage to crops, bees, animals etc
- Contamination of produce - illegal residues
- Environmental contamination
- Adverse health effects – humans, animals
- Loss of pesticide and reduced efficacy
- Adverse publicity
- Litigation



Causes of drift

- Inappropriate droplet size for:
  - **pesticide**
  - **weather conditions**
  - **situation**
- Inappropriate pesticide or formulation

Causes of drift

Spraying in adverse weather conditions

- **(wind velocity, temperature, humidity, atmos. stability)**



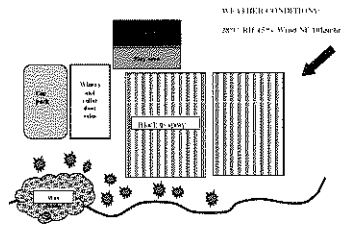
….causes of drift

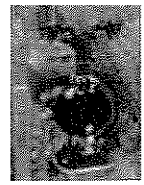
- Inappropriate equipment or equipment set up
  - **Distance droplets have to travel to target**
  - **Tractor speed – droplets carried up**
  - **Nozzles, pressure**





Managing drift is managing risk

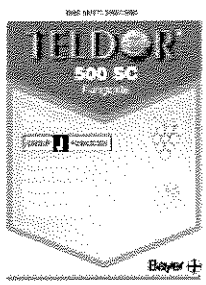






Managing drift - 9 steps to take

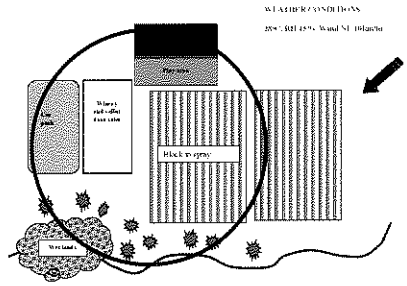
1. Select low hazard products
2. Read the label!!



Managing drift

3. Identify sensitive areas (awareness zone)

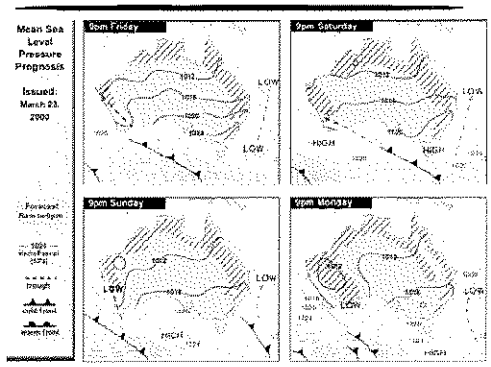
   Risk assessment



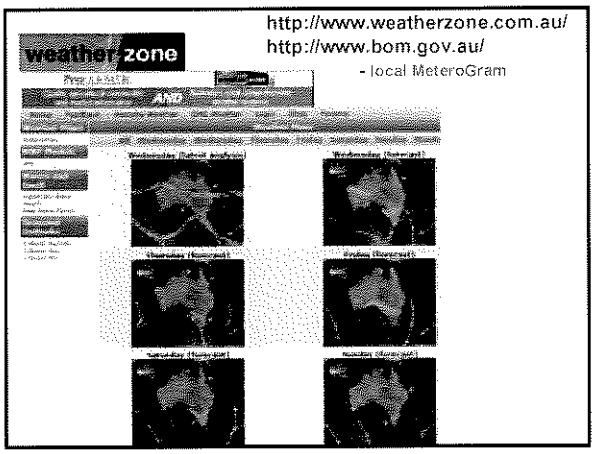
Steps in drift management con't...

4. Communicate
   - **NSW – draft regulation for compulsory notification**
5. Avoid adverse weather conditions
   - **Check forecast**
   - **Check weather when spraying**
     - Wind
     - Temperature and humidity
     - Atmospheric stability

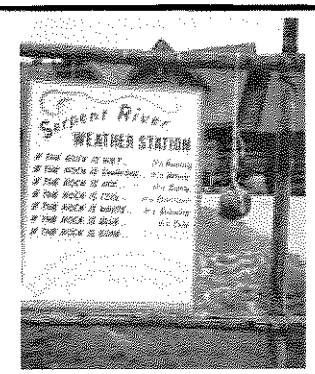
Weather forecast?



http://www.weatherzone.com.au/
http://www.bom.gov.au/
- local MeteroGram



On the spot weather station



Wind ...

- Wind direction
  - **Do not spray if wind is blowing towards susceptible areas**
  - **Start at the downwind side and work into the wind**
  - **Be alert to changes during the job**
- Wind speed
  - **Major factor in drift**
  - **Ideal – light and steady**
  - **Not dead calm if inversion present**
  - **Measure and record**

Temperature

- Ideal: 10 to 30°C and some humidity
  - **If < 10 °C ????**
    - Frost, dew, inactive plants & insects
  - **If > 30 °C ????**
    - Stressed plants, stressed operator, phytotoxicity, high evaporation, volatilisation
    - Avoid temperatures > 35 °C

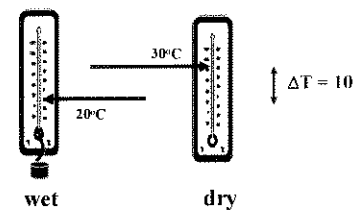
Temperature near ground level critical!

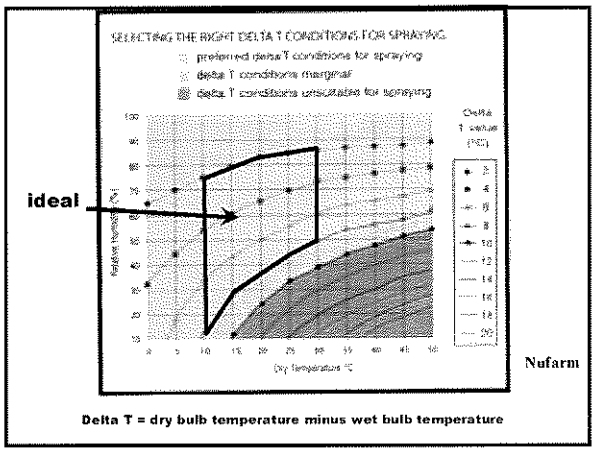
Humidity

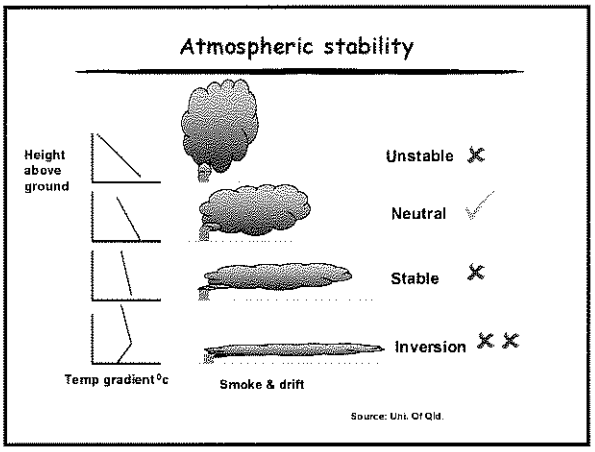
- **If low humidity ....**
  - High evaporation
- **If high humidity ....**
  - Reduced evaporation – extends droplet life
- **Ideal - ΔT 2 – 8 °C**
  - Avoid low relative humidity (ΔT > 10°C)

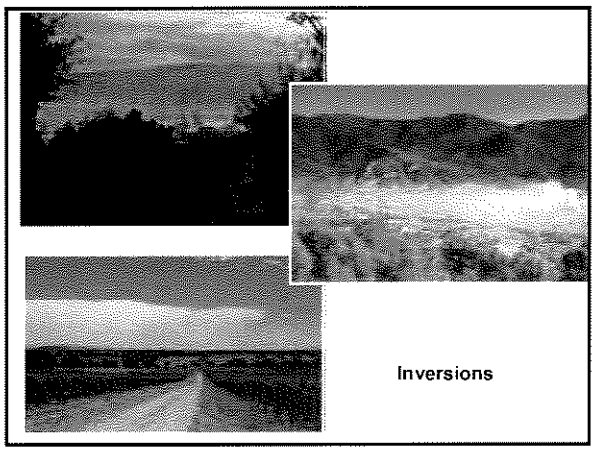
Measuring humidity

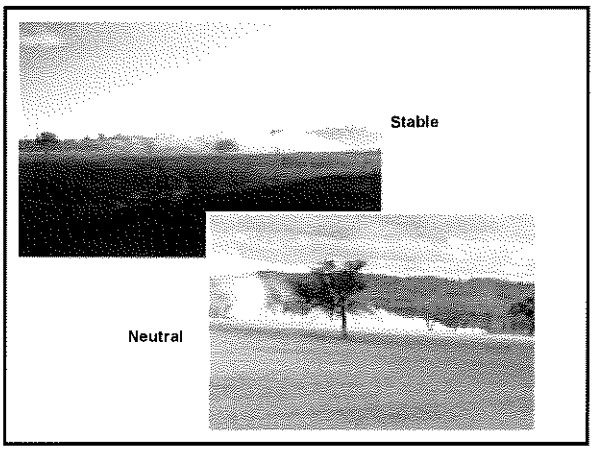
- Weather meter - % humidity
- Wet and dry bulb thermometer - ΔT and % humidity

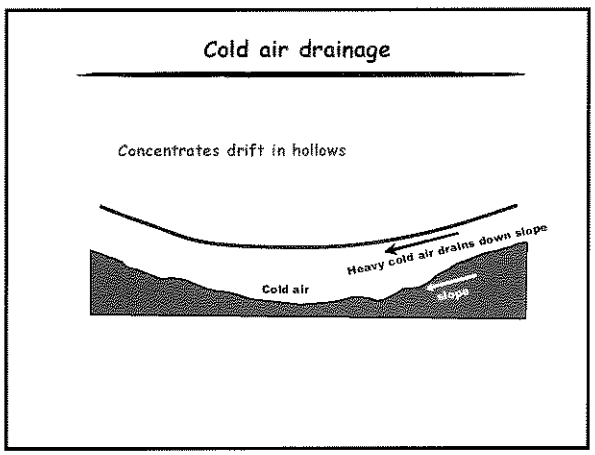


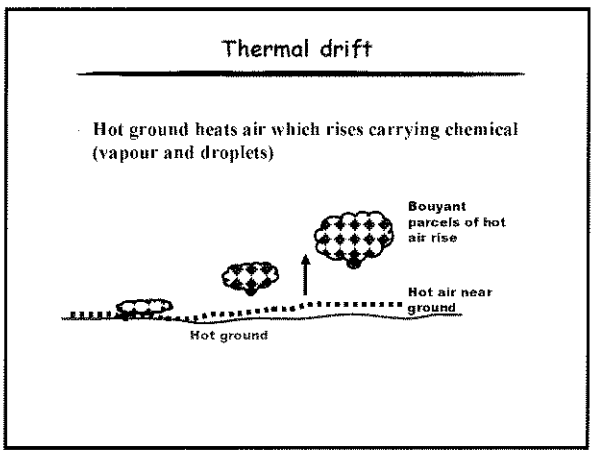

SELECTING THE RIGHT DELTA T CONDITIONS FOR SPRAYING
preferred delta T conditions for spraying
delta T conditions marginal
delta T conditions unsuitable for spraying
ideal
Nufarm
Delta T = dry bulb temperature minus wet bulb temperature


Atmospheric stability
Height above ground
Unstable
Neutral
Stable
Inversion
Temp gradient °c
Smoke & drift
Source: Uni. Of Qld.


Inversions


Stable
Neutral


Cold air drainage
Concentrates drift in hollows
Heavy cold air drains down slope
Cold air
slope

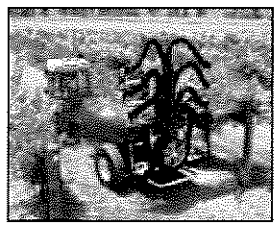
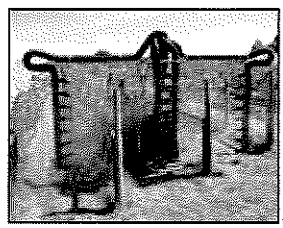

Thermal drift
Hot ground heats air which rises carrying chemical (vapour and droplets)
Bouyant parcels of hot air rise
Hot air near ground
Hot ground

Steps in drift management con't...

6. Control droplet size:
   - **Select appropriate pressure or CDA rotation speed**
   - **Select appropriate nozzle type & size**
   - **Use spray adjuvants to increase droplet size e.g.**
     - Anti-evaporants
     - Oils
     - Liquid polymers

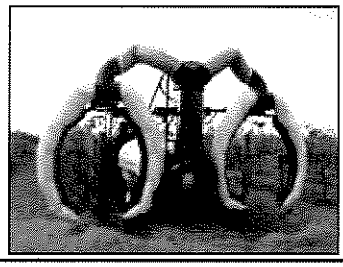
Steps in drift management con't...

7. Control droplet trajectory:
   - **Minimise release height**
   - **Direct spray (& air) to target**

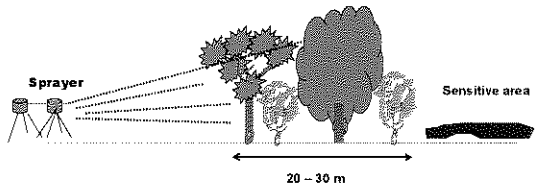
Steps in drift management con't...

8. Modify sprayer
   - **Hoods, covers, shields**

Steps in drift management con't...

9. Use buffer zones
   - **No-spray areas**
   - **Vegetation buffers**



Take home message

- Pesticide application and drift management is a complex process
- Every situation is different – understand the variables
- Managers need to take responsibility for practices in their own workplace
- Take a risk management approach

... the take home message

- Adjust sprayer to the canopy – adjustment is more important than type of sprayer
- Air:
  - **Needed for spray penetration**
  - **Direct air to canopy – converging air is best**
  - **Adjust fan and speed to give right quantity**
- Sprays:
  - **Fine to medium droplets**
  - **Increase volume as canopy grows – no runoff**
  - **To increase volume, increase number of nozzles or slow sprayer down**

... the take home message

- Calibrate the sprayer
- Use all appropriate drift management techniques
- Keep records
- Competent operators

"Spraying is nearly always a compromise between what is ideal and what must be done!"

Thankyou

Reference:

- "Spray Application in Vineyards", Kent & Early. Charles Sturt University

Alison MacGregor

Alison MacGregor has been at the Department of Primary Industry in Mildura since 1988. Through research on the persistence and degradation of agrochemicals on fresh and dried grapes and in wine, she contributed significantly to the development of the industry 'Restrictions on use' that ensure that agrochemical residues in our wine are below the tolerance limits set by overseas buyers of Australian wine. She has been involved in research and extension on integrated pest management and spray application, towards improving the effectiveness of agrochemical applications. She was recently involved in research to: a) develop prescriptions for using adjuvants to improve the penetration of fungicides into grape bunches, in collaboration with HortResearch NZ and Plant Protection Chemistry NZ, and b) assess the movement, and potential impacts of agrochemicals within and beyond the vineyard. She is now working on two aspects of application specific to dried grape industry (cordon bunch removal and improving the efficiency of applying drying emulsion).

"References for further reading of Alisons work includes

Alison MacGregor, David Riches, Robyn Gaskin, David Manktelow, 2003 "Better Disease Control Using Adjuvents", 475 August 2003

Alison MacGregor, Mahababur Mollah, Adam Wightwick, Gary Dorr, Nicholas Woods, John Reynolds 2004 "Spray drift: The proportion that drifts out of the vineyard is small compared with the proportion that gets wasted on the ground" Australian and New Zealand Grapegrower and Winemaker No 481 February 2004"

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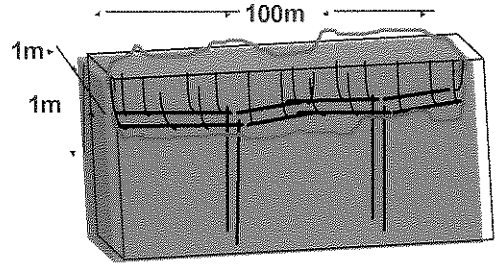


How much water must leave the tank for enough to land on the canopy?

Alison MacGregor
C. Jaeger, M. Warren, K. Murphy, D. Riches, P. Kooij, A. Hill, D. Glenn, G. Furness.

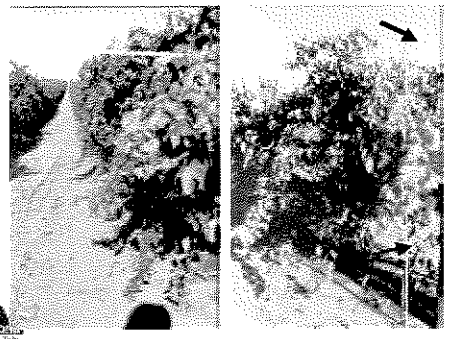


Unit Canopy Row
method for estimating water volumes
Cubic Metres Canopy



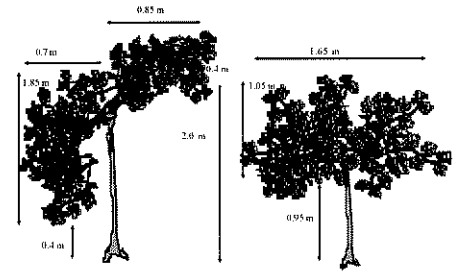
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Spraying swing arm canopies



3

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4

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We measured actual leaf area

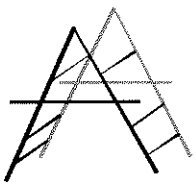


Figure 1 (above): A-frame 'ladder' constructed using dowel rod and joiners at 30 to 55 cm from the vine trunk in each plot, to define the area for defoliation.

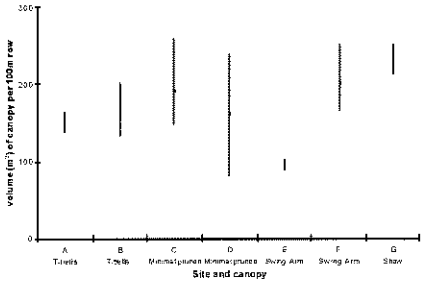
Figure 2 (right): 25-cm slice in the T-trellis after leaf removal.



5

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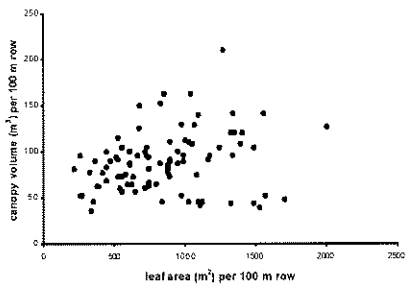
Wide range in canopy volumes



Mean and range of canopy volumes (m^3/100m) derived using unit canopy row.

6

Volume versus Leaf Area



The estimated canopy volumes (m³/100m) correlated very poorly against actual leaf area (m²/100m) (adjusted R^2 = 0.043).

7

Assessing deposition

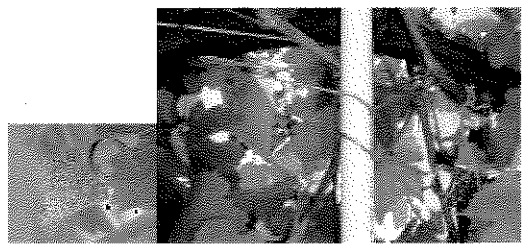


Figure 1: Water sensitive papers in both horizontal and vertical clips in a grapevine canopy. The blue colour appears wherever a spray droplet deposits on the yellow card.

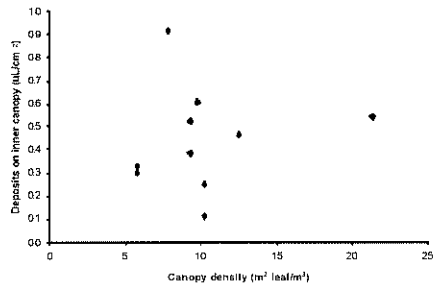
8

A few sampling positions



9

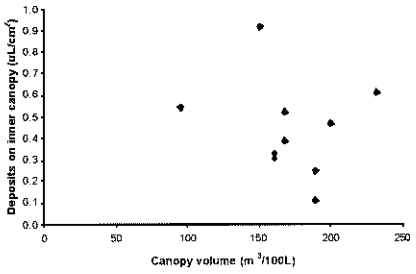
Density didn't affect deposition



Canopy density was not correlated with deposition of spray (µL/cm²) in the inner canopy.

10

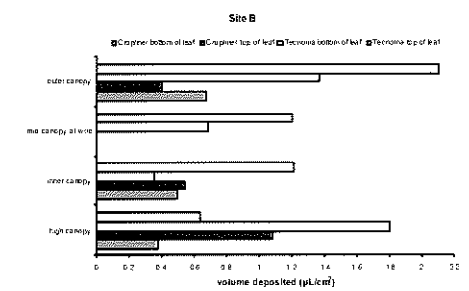
Volume didn't affect deposition



Canopy volume (m3/100m) was not correlated with deposition of spray (µL/cm²) in the inner canopy.

11

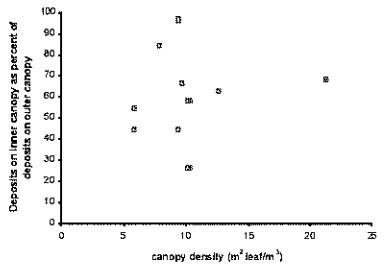
Sprayer versus leaf position



Volume of spray deposit (µL/cm²) estimated from the number and average size of deposits on water sensitive papers from several positions in each canopy. The Tecnoma deposits are normalised to standardise the application volume with that from the Cropliner (16.7 L/100 m).

12

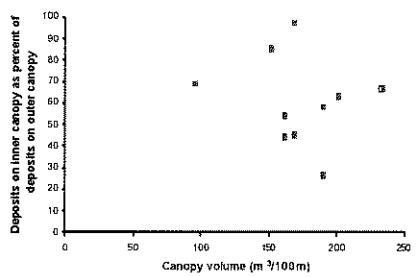
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Canopy density was not correlated with the proportion (%) of spray reaching the inner compared to outer canopy

13

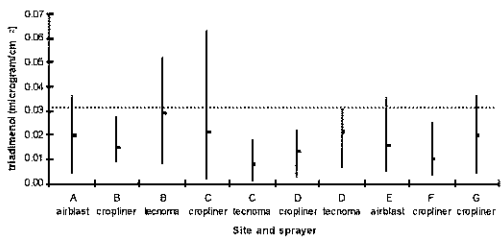
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Canopy volume (m3:100m) was not correlated with the proportion (%) of spray reaching the inner compared to outer canopy

14

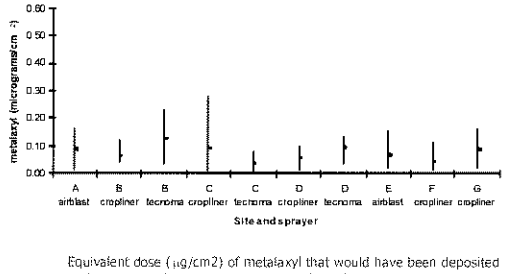
DEPARTMENT OF PRIMARY INDUSTRIES



Equivalent dose (μg/cm^2) of triadimenol that would have been deposited on leaves in each canopy, extrapolated from the maximum, minimum and mean water deposits measured on water sensitive papers. 0.0275 μg/cm^2 triadimenol is required for 99% control of powdery mildew (Riches *et al.* 2002).

15

DEPARTMENT OF PRIMARY INDUSTRIES



Equivalent dose (μg/cm2) of metalaxyl that would have been deposited on leaves in each canopy, extrapolated from the maximum, minimum and mean water deposits measured on water sensitive papers. 1.1 μg/cm2 metalaxyl is required for 99% control of downy mildew (Riches *et al.* 2002).

16

DEPARTMENT OF PRIMARY INDUSTRIES

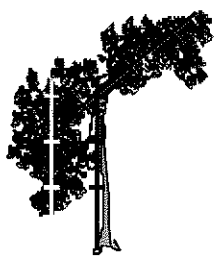
Get it right, then don't change it?

Four spray dates

Same set up or changing set up

9 sampling positions

We compared deposits



DEPARTMENT OF PRIMARY INDUSTRIES

Adjusting the set-up paid off

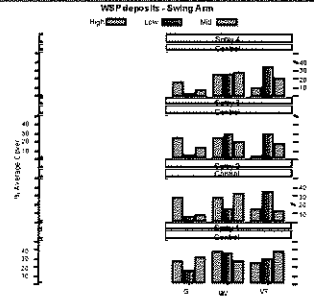


Figure 5: Coverage (%) of papers collected from 9 sampling positions in the Sheegarm canopy, over four successive spray dates. Each value is an average of both sides of the water sensitive paper, representing both sides of a leaf. LSD = 14.356 when comparing means within the same spray date. Position S implies the gable pole, position MV implies mid-way pole, position VT implies wire trunkline.

18

DEPARTMENT OF PRIMARY INDUSTRIES

Adjusting the set-up paid off

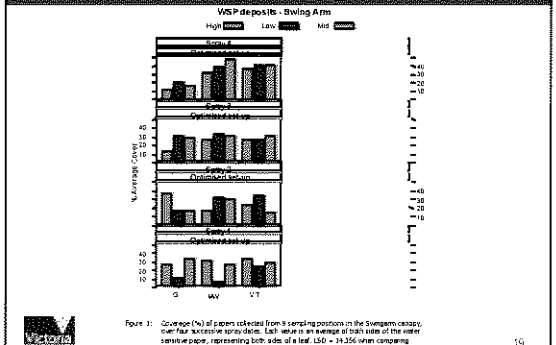


Figure 1: Coverage (%) of papers collected from 9 sampling positions in the Swingarm canopy, over four successive spray dates. Each value is an average of both sides of the water sensitive paper, representing both sides of a leaf. LSD = 14.256 when comparing means within the same spray date. Position G implies the gable pole, position MW implies mid way pole, position VT implies vine trunkline.

19

DEPARTMENT OF PRIMARY INDUSTRIES

Adjusting the set-up paid off

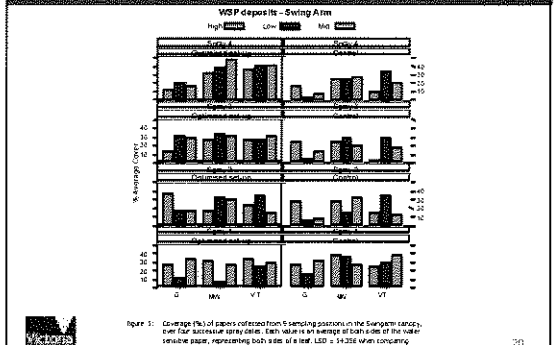


Figure 1: Coverage (%) of papers collected from 9 sampling positions in the Swingarm canopy, over four successive spray dates. Each value is an average of both sides of the water sensitive paper, representing both sides of a leaf. LSD = 14.256 when comparing means within the same spray date. Position G implies the gable pole, position MW implies mid way pole, position VT implies vine trunkline.

20

DEPARTMENT OF PRIMARY INDUSTRIES

Adjusting the set-up paid off

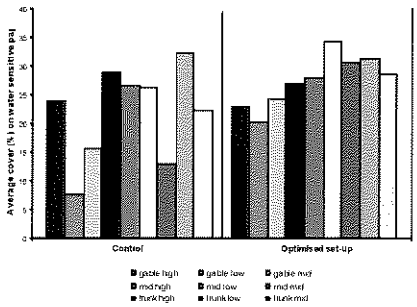


Figure 1: Deposits in different positions within the Swingarm canopy, averaged across the four spraying dates (n=6).

21

DEPARTMENT OF PRIMARY INDUSTRIES

Adjusting the set-up paid off

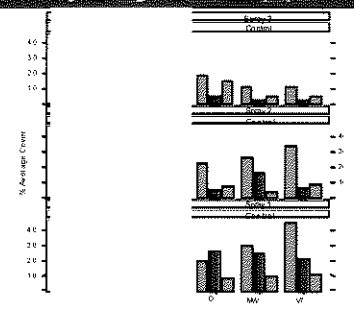


Figure 1: Coverage (%) of papers collected from 9 sampling positions in the minimally pruned canopy, over three successive spray dates. The data shown are backtransformed. G implies the outer pole, MW implies the middle pole and VT implies the pole adjacent to the vine trunk.

22

DEPARTMENT OF PRIMARY INDUSTRIES

Adjusting the set-up paid off

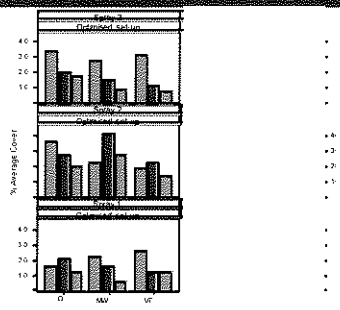


Figure 1: Coverage (%) of papers collected from 9 sampling positions in the minimally pruned canopy, over three successive spray dates. The data shown are backtransformed. G implies the outer pole, MW implies the middle pole and VT implies the pole adjacent to the vine trunk.

23

DEPARTMENT OF PRIMARY INDUSTRIES

Adjusting the set-up paid off

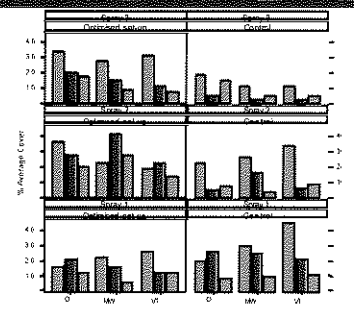


Figure 1: Coverage (%) of papers collected from 9 sampling positions in the minimally pruned canopy, over three successive spray dates. The data shown are backtransformed. G implies the outer pole, MW implies the middle pole and VT implies the pole adjacent to the vine trunk.

24

DEPARTMENT OF PRIMARY INDUSTRIES

How do you work out volume?

- Depends on the canopy
- Get the air right
- Get the setup right
- Then choose a volume that will wet (=dose) the inner canopy

25

DEPARTMENT OF PRIMARY INDUSTRIES

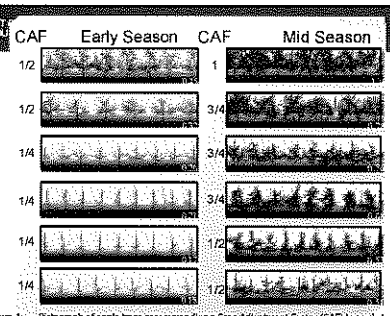


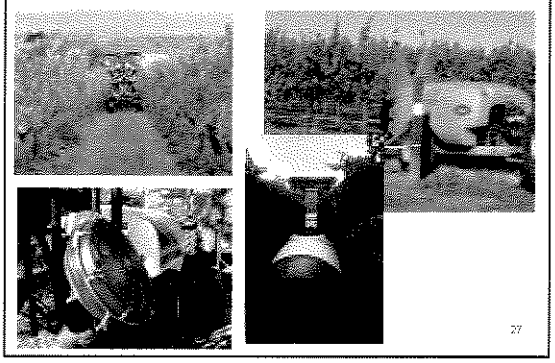
Figure 1: Pictograph of apple trees recommending a Crop Adjustment Factor (CAF) to apply to adjust water volumes for six examples of tree density, at two growth stages (Walkiate and Cross, undated). *

* Image Courtesy of Peter Walklate (Silsoe Research Institute UK) and Jerry Cross (HRI East Malling, UK). The work was funded by the Pesticide Safety Directorate of the Department of Environment Food and Rural Affairs in the UK.

26

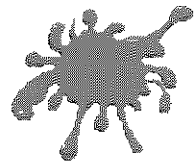
DEPARTMENT OF PRIMARY INDUSTRIES

Make sure droplets cover their target



27

DEPARTMENT OF PRIMARY INDUSTRIES



28

Quantifying off-target movement of pesticides from vineyards

Alison MacGregor, Mahabubur Mollah, Gary Dorr
John Reynolds, Adam Wightwick, Nicholas Woods

www.crcv.com.au

- Australia's leading viticultural research and development organisation – a joint venture between Australia's leading research and education agencies
- Conducting collaborative research, utilising the broad range of skills and expertise within the industry and maximizing research outputs for the industry
- Currently committed to accelerating quality viticultural management from grapevine to palate
- Ensuring the economic and environmental sustainability of Australia's grapegrowing and winemaking industries

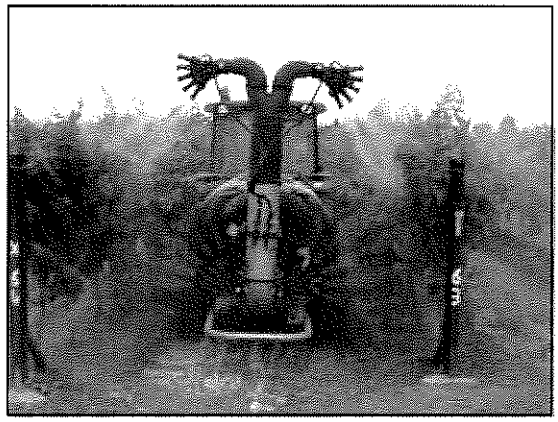
www.crcv.com.au

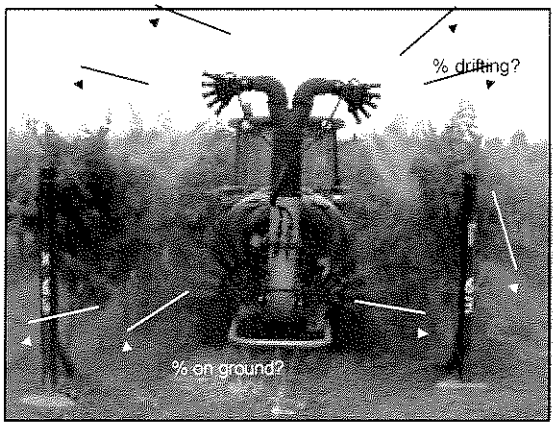
Project funders:
- Department of Primary Industries (DPI), Victoria
- CRC for Viticulture

and thank you to...

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Paul Burrow
Clint Williams - GBC Motors
David Carr - Silvan Aust
Linda Pollock - DPI
Julian Connellan - VAMVIA
Ary Hoffmann - CESAR

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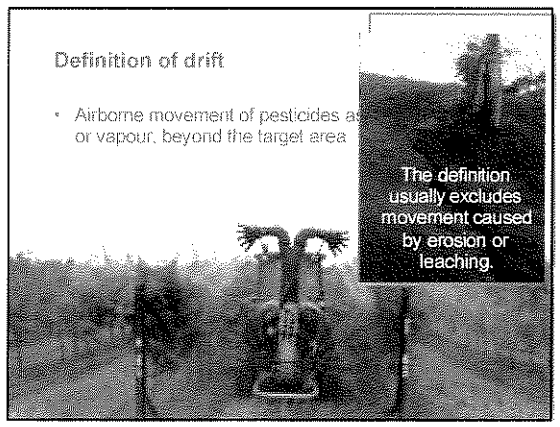


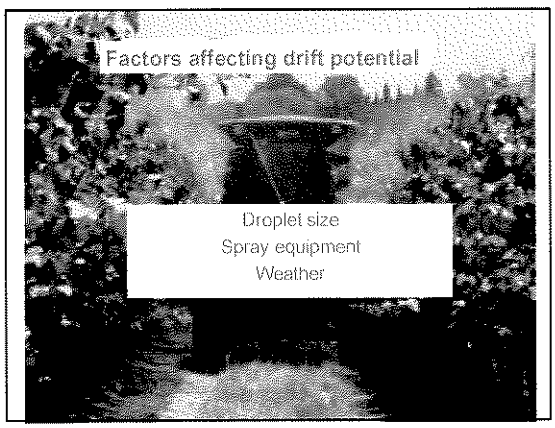


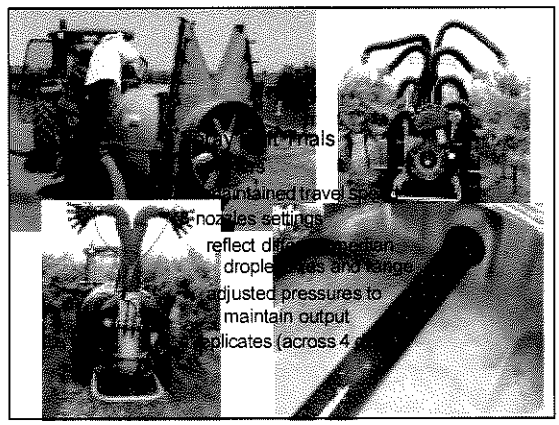
Definition of drift

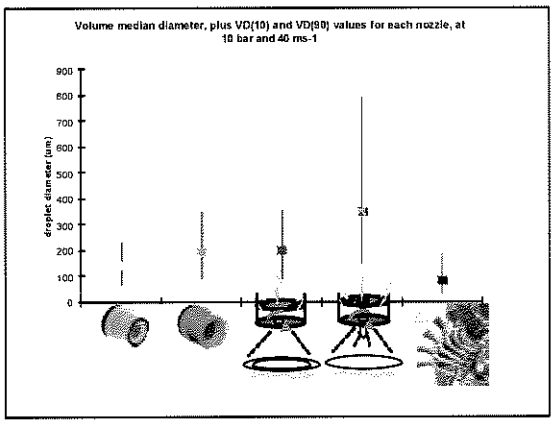
- Airborne movement of pesticides as
  or vapour, beyond the target area

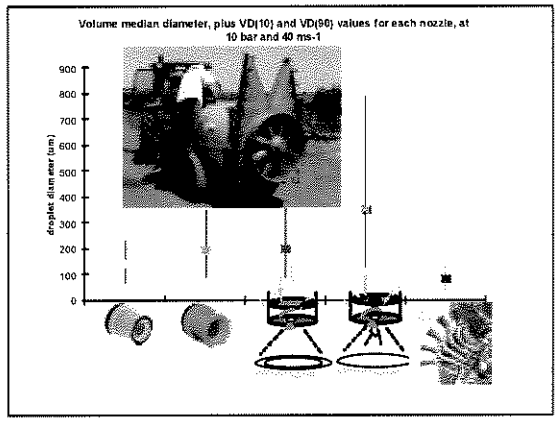
The definition usually excludes movement caused by erosion or leaching.

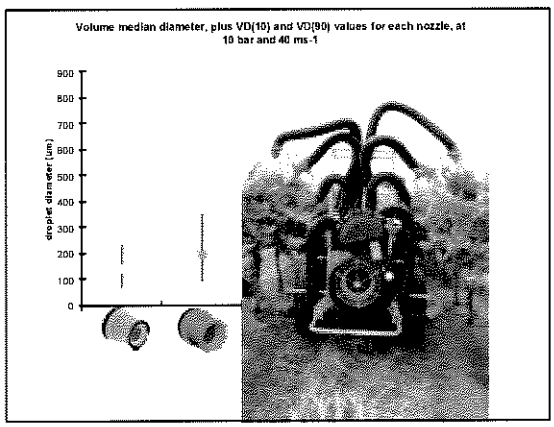


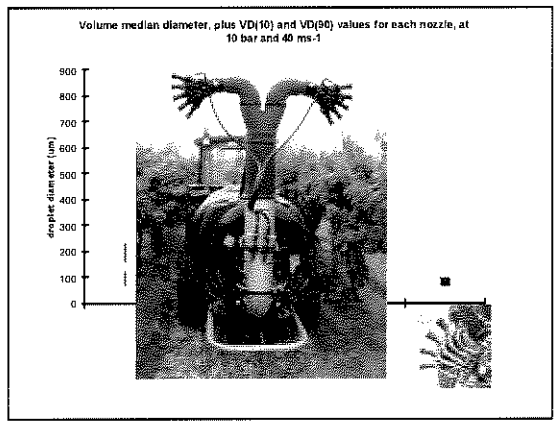

Factors affecting drift potential
Droplet size
Spray equipment
Weather

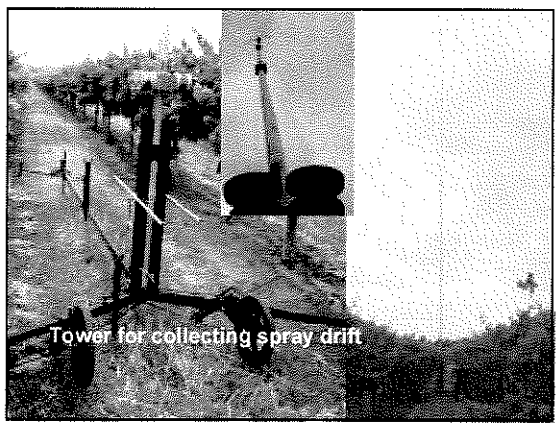

nozzles settings
reflect
droplet
adjusted pressures to
maintain output

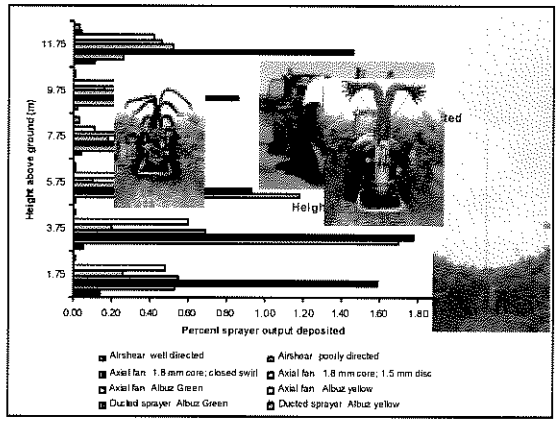

Volume median diameter, plus VD(10) and VD(90) values for each nozzle, at 10 bar and 40 ms-1
droplet diameter (um)
900
800
700
600
500
400
300
200
100
0

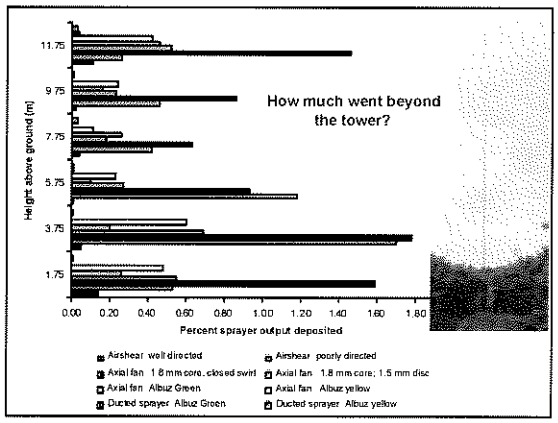

Volume median diameter, plus VD(10) and VD(90) values for each nozzle, at 10 bar and 40 ms-1
droplet diameter (um)
900
800
700
600
500
400
300
200
100
0

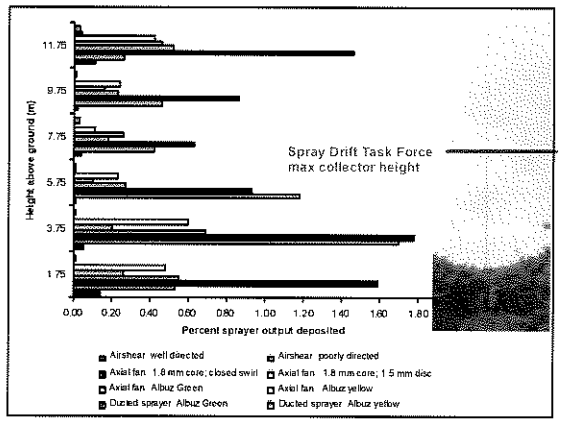

Volume median diameter, plus VD(10) and VD(90) values for each nozzle, at 10 bar and 40 ms-1
droplet diameter (um)
900
800
700
600
500
400
300
200
100
0

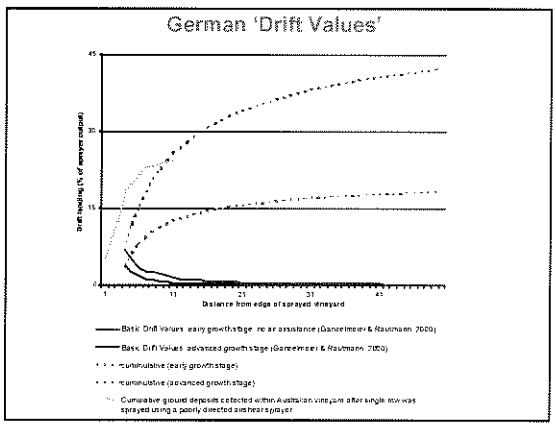

Volume median diameter, plus VD(10) and VD(90) values for each nozzle, at 10 bar and 40 ms-1
droplet diameter (um)
900
800
700
600
500
400
300
200
100
0

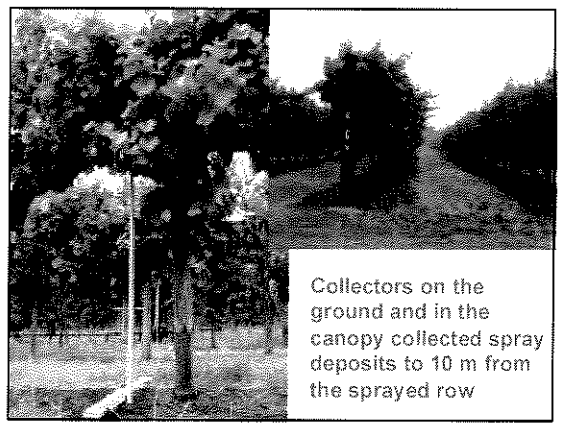

Tower for collecting spray drift

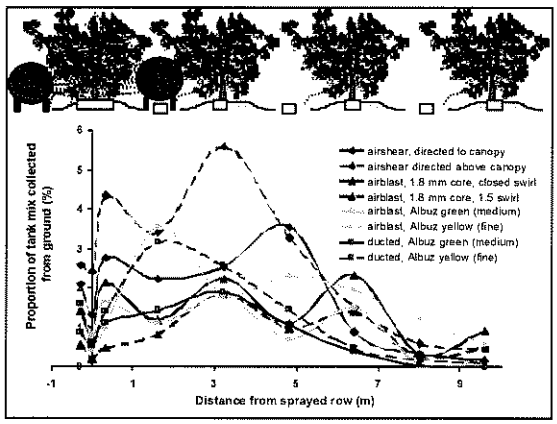

Height above ground (m)
11.75
9.75
7.75
5.75
3.75
1.75
0.00 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80
Percent sprayer output deposited
Airshear well directed
Airshear poorly directed
Axial fan 1.8 mm core; closed swirl
Axial fan 1.8 mm core; 1.5 mm disc
Axial fan Albuz Green
Axial fan Albuz yellow
Ducted sprayer Albuz Green
Ducted sprayer Albuz yellow

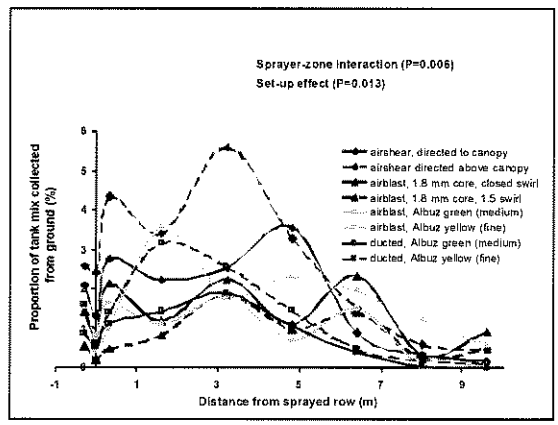

How much went beyond the tower?
Height above ground (m)
11.75
9.75
7.75
5.75
3.75
1.75
0.00 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80
Percent sprayer output deposited
Airshear well directed
Airshear poorly directed
Axial fan 1.8 mm core, closed swirl
Axial fan 1.8 mm core; 1.5 mm disc
Axial fan Albuz Green
Axial fan Albuz yellow
Ducted sprayer Albuz Green
Ducted sprayer Albuz yellow

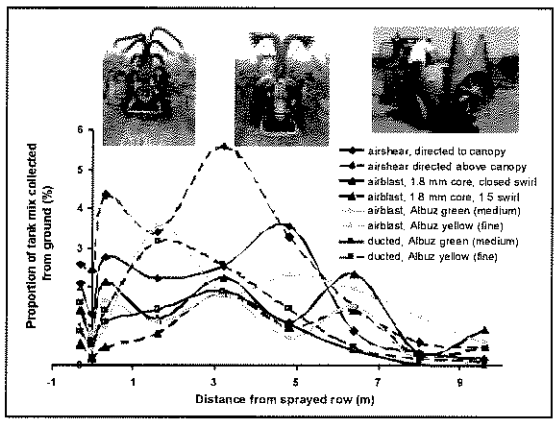

Spray Drift Task Force max collector height
Height above ground (m)
11.75
9.75
7.75
5.75
3.75
1.75
0.00 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80
Percent sprayer output deposited
Airshear well directed
Airshear poorly directed
Axial fan 1.8 mm core; closed swirl
Axial fan 1.8 mm core; 1.5 mm disc
Axial fan Albuz Green
Axial fan Albuz yellow
Ducted sprayer Albuz Green
Ducted sprayer Albuz yellow

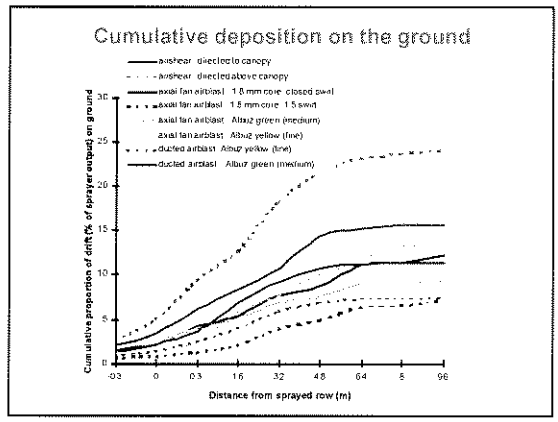

German 'Drift Values'
45
30
15
0
1
11
21
31
41
Distance from edge of sprayed vineyard
Basic Drift Values early growth stage no air assistance (Ganzelmeier & Rautmann 2000)
Basic Drift Values advanced growth stage (Ganzelmeier & Rautmann 2000)
cumulative (early growth stage)
cumulative (advanced growth stage)
Cumulative ground deposits collected within Australian vineyard after single row was sprayed using a poorly directed airshear sprayer

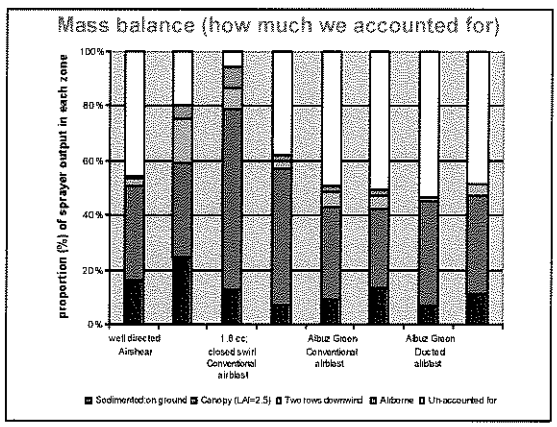

Collectors on the ground and in the canopy collected spray deposits to 10 m from the sprayed row

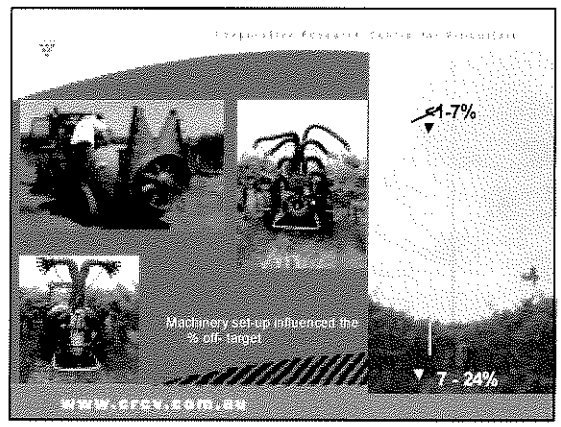

Proportion of tank mix collected from ground (%)
Distance from sprayed row (m)
airshear, directed to canopy
airshear directed above canopy
airblast, 1.8 mm core, closed swirl
airblast, 1.8 mm core, 1.5 swirl
airblast, Albuz green (medium)
airblast, Albuz yellow (fine)
ducted, Albuz green (medium)
ducted, Albuz yellow (fine)

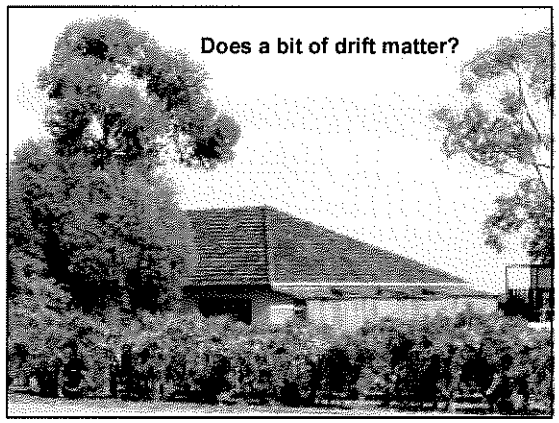

Sprayer-zone interaction (P=0.006)
Set-up effect (P=0.013)
Proportion of tank mix collected from ground (%)
Distance from sprayed row (m)
airshear, directed to canopy
airshear directed above canopy
airblast, 1.8 mm core, closed swirl
airblast, 1.8 mm core, 1.5 swirl
airblast, Albuz green (medium)
airblast, Albuz yellow (fine)
ducted, Albuz green (medium)
ducted, Albuz yellow (fine)

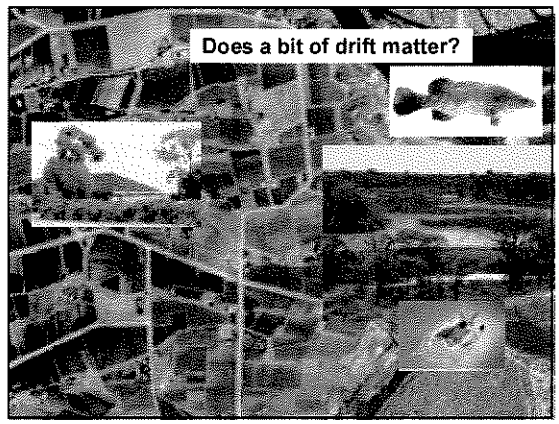

Proportion of tank mix collected from ground (%)
Distance from sprayed row (m)
airshear, directed to canopy
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airblast, 1.8 mm core, closed swirl
airblast, 1.8 mm core, 1.5 swirl
airblast, Albuz green (medium)
airblast, Albuz yellow (fine)
ducted, Albuz green (medium)
ducted, Albuz yellow (fine)

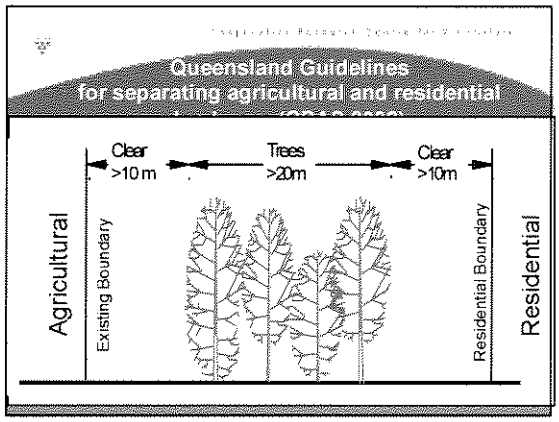

Cumulative deposition on the ground
Cumulative proportion of drift (% of sprayer output) on ground
Distance from sprayed row (m)

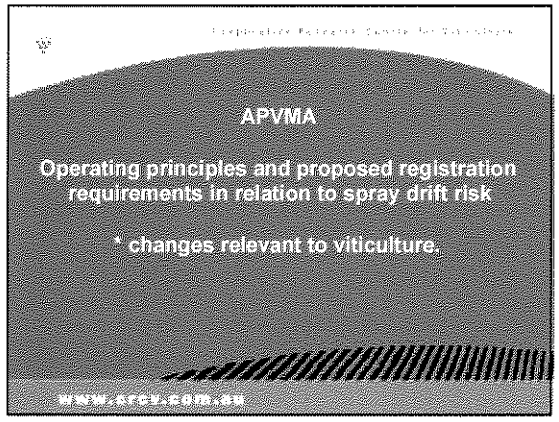

Mass balance (how much we accounted for)
proportion (%) of sprayer output in each zone
well directed Airshear
1.8 cc; closed swirl Conventional airblast
Albuz Green Conventional airblast
Albuz Green Ducted airblast
Sedimented on ground
Canopy (LAI=2.5)
Two rows downwind
Airborne
Un-accounted for

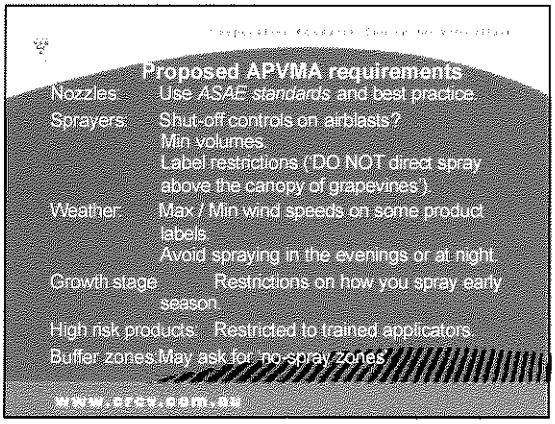

1-7%
Machinery set-up influences the % off- target
7 - 24%

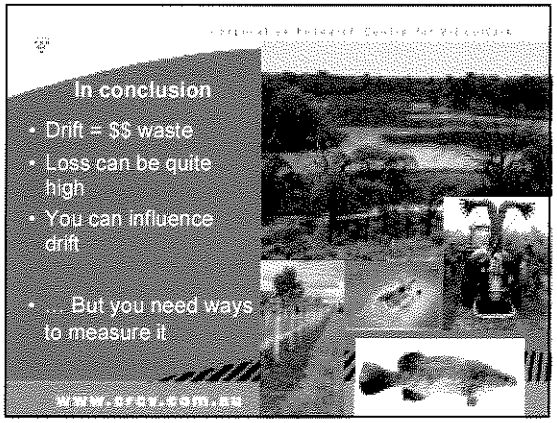

Does a bit of drift matter?


Does a bit of drift matter?


Queensland Guidelines
for separating agricultural and residential
Clear
>10 m
Trees
>20m
Clear
>10m
Agricultural
Existing Boundary
Residential Boundary
Residential


APVMA
Operating principles and proposed registration requirements in relation to spray drift risk
* changes relevant to viticulture.
www.arcv.com.au


Proposed APVMA requirements
Nozzles: Use ASAE standards and best practice
Sprayers: Shut-off controls on airblasts?
Min volumes
Label restrictions ('DO NOT direct spray above the canopy of grapevines')
Weather: Max / Min wind speeds on some product labels
Avoid spraying in the evenings or at night
Growth stage: Restrictions on how you spray early season
High risk products: Restricted to trained applicators
Buffer zones: May ask for 'no-spray zones'
www.arcv.com.au


In conclusion
• Drift = $$ waste
• Loss can be quite high
• You can influence drift
• ...But you need ways to measure it
www.arcv.com.au

DEPARTMENT OF PRIMARY INDUSTRIES

Using super-spreaders to improve disease control



GWRDC

HortResearch PPCNZ Nufarm

Research team

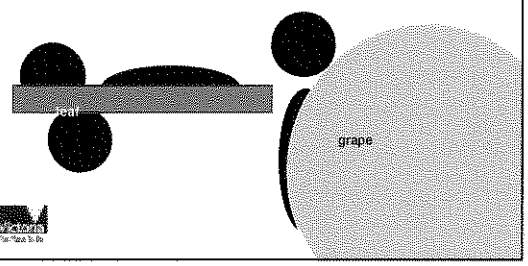
- **Alison MacGregor**
  - DPI
- **David Riches**
  - DPI
- **David Manktelow**
  - HortResearch
- **Robyn Gaskin**
  - PPC NZ
- **Nufarm**
- **Bayer**



DEPARTMENT OF PRIMARY INDUSTRIES

Surface tension

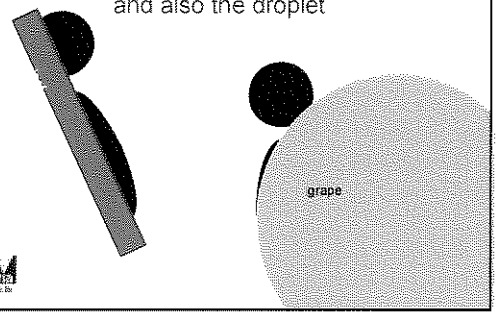
Spread depends on properties of the surface and also the droplet



DEPARTMENT OF PRIMARY INDUSTRIES

Surface tension

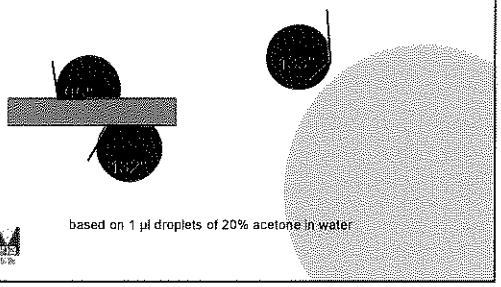
Spread depends on properties of the surface and also the droplet



DEPARTMENT OF PRIMARY INDUSTRIES

Laboratory trials (NZ)

How easily can we 'wet' grape and leaf surfaces ?



based on 1 µl droplets of 20% acetone in water

Key questions:

- How easily can we 'wet' grape and leaf surfaces ?
- Do formulations affect wetting ?
- Can we:
  - get more spray into bunches by reducing surface tension ?
  - reduce spray volumes by improving wetting ?
  - improve disease control by improving wetting ?
- What are the best fungicide + adjuvants mixtures ?

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How do the adjuvants behave when mixed with typical tank mixes?

- 10 tank mixes tested
  - stability
  - spread

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Budburst to flowering

Treatment	Tank mixes	
	Active ingredient	Product
1	sulphur mancozeb	Microthiol Dispersable Penncozeb 750 DF
2	sulphur captan	Microthiol Dispersable Captan
3	sulphur copper hydroxide	Microthiol Dispersable Champ DP
4	spiroxamine mancozeb	Prosper Penncozeb 750 DF

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DEPARTMENT OF PRIMARY INDUSTRIES

Flowering to berry-set

Treatment	Tank mixes	
	Active ingredient	Product
5	triadimenol mancozeb *Bacillus thuringiensis*	Bayfidan Penncozeb 750 DF Dipel
6	pyrimethanil copper hydroxide sulphur *Bacillus thuringiensis*	Scala Champ DP Microthiol Dispersable Dipel
7	chlorothalonil sulphur *Bacillus thuringiensis*	Elect 720 Microthiol Dispersable Dipel
8	*Bacillus thuringiensis* pyrimethanil trifloxystrobin	Dipel Scala Flint
9	fenhexamid sulphur *Bacillus thuringiensis*	Teldor Microthiol Dispersable Dipel

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Berry-set to bunch-closure

Treatment	Tank mixes	
	Active ingredient	Product
10	iprodione *Bacillus thuringiensis* metalaxyl	Rovral Dipel Ridomil

- All products tested at dilute (1x) and concentrate (3x) rates
- Adjuvants were also tested at a range of rates

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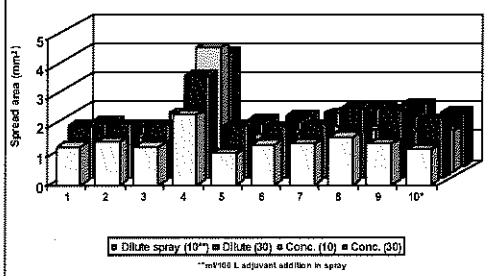
Adjuvants

Adjuvant type	example	Rate (mL/100L) *bold = label recommended rate*
Non-ionic spreader (nonyl-phenol ethoxylate)	Agral®	**10** 30 (D and C)
Non-ionic spreader (alcohol ethoxylate)	BS1000®	**40** and 120 mL (D and C)
'Pure' organosilicone super-spreader	Pulse®	25 and **50** mL in dilute mix **50** and 100 mL in conc. mix
Organosilicone blend	Under permit (not yet registered)	50 and 75 mL in dilute mix 150 and 225 in conc. mix
Sticker-spreader Latex + organosilicone	Bond Extra®	**100 and 150** mL in dilute mix 300 and 450 mL in conc. mix

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Laboratory screening (NZ)

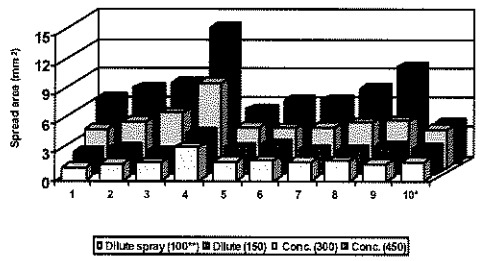


Effect of **Agral** concentration on droplet spread, on grape berries

12

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Laboratory screening (NZ)

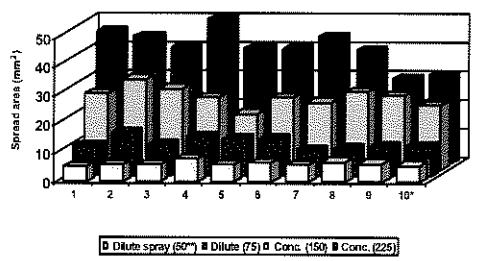


Effect of **OS+** concentration on droplet spread, on grape berries

13

DEPARTMENT OF PRIMARY INDUSTRIES

Laboratory screening (NZ)



Effect of **OSB** concentration on droplet spread, on grape berries

14

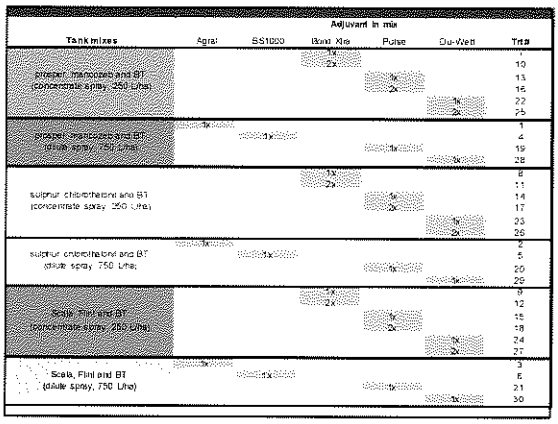
DEPARTMENT OF PRIMARY INDUSTRIES

Would OS cause phytotoxicity ?

- Chardonnay sprayed at flowering
- 30 treatments
  - 5 adjuvants
    - Pulse, DuWett, Agral, Chemwet Designer,
  - 2 volumes
    - 250 L/ha, 750 L/ha
  - 3 tank mixes
    - Sulphur, Chlorothalonil and BT
    - Prosper, Mancozeb and BT
    - Scala, Flint and BT
- 8 replicates
  - randomised block design
    aimed to show treatment equivalence (rather than difference)



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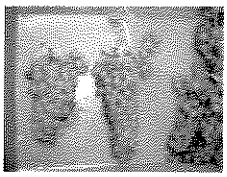


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Would OS cause phytotoxicity ?

Bunches tagged
- 10 per plot
- 8 plots per treatment





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Would OS cause phytotoxicity ?

- Bunch weight ?
  - no significant effect of adjuvant, rate or fungicide
- Bunch damage ?
  - no significant effect of adjuvant, rate or fungicide



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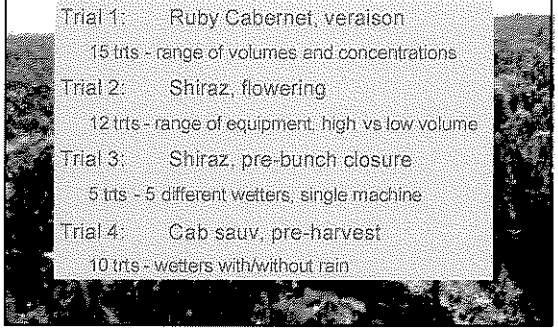
Do super-wetters increase spray deposits inside bunches?

Trial 1: Ruby Cabernet, veraison
15 trts - range of volumes and concentrations

Trial 2: Shiraz, flowering
12 trts - range of equipment, high vs low volume

Trial 3: Shiraz, pre-bunch closure
5 trts - 5 different wetters, single machine

Trial 4: Cab sauv, pre-harvest
10 trts - wetters with/without rain



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Our questions ...

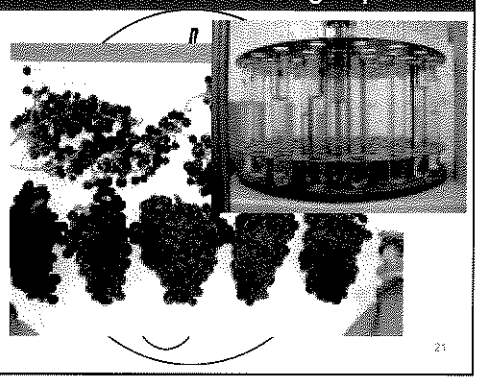
Were there treatment effects on:

- Botrytis control in bunch centres?
- Spread of dye into bunch centres?
- Spread into tight compared to loose bunches?

20

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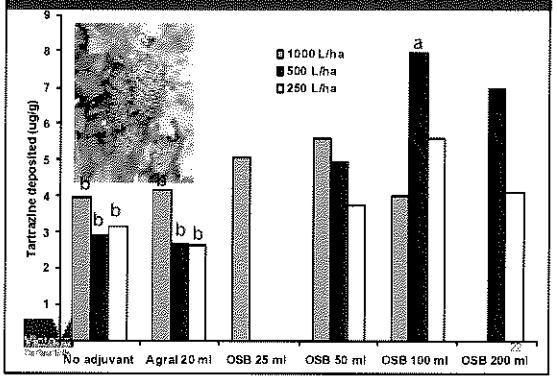
Measuring deposits



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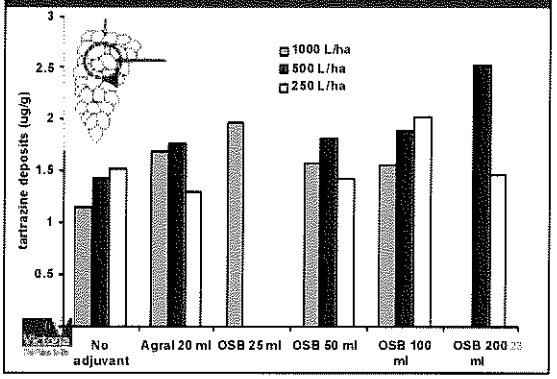
Tartrazine deposits in tight bunches



22

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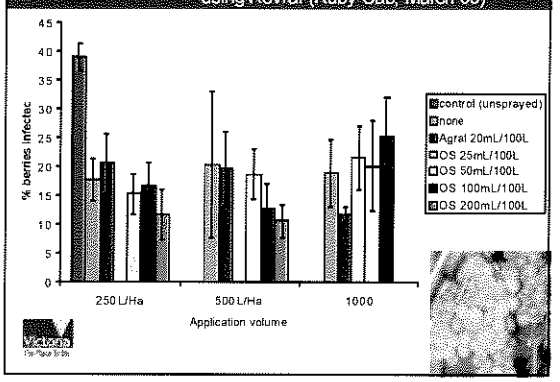
Tartrazine deposits in bunch centres



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DEPARTMENT OF PRIMARY INDUSTRIES

Effect of adjuvant on *Botrytis* control achieved using Rovral (Ruby Cab, March 03)

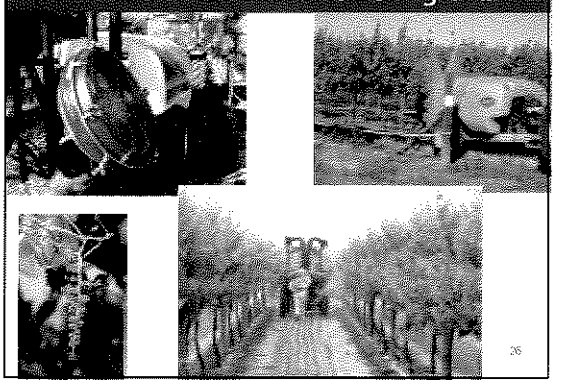


Flowering trial – Nov 2003

- Shiraz
- inoculated - Botrytis, downy mildew
- chlorothalonil, sulphur
- compared Agral, OSB, no adjuvant
- compared volumes
  - 200 L/ha
  - 600 L/ha
- compared machinery
  - Quantam mist
  - Airblast
  - Turbomiser

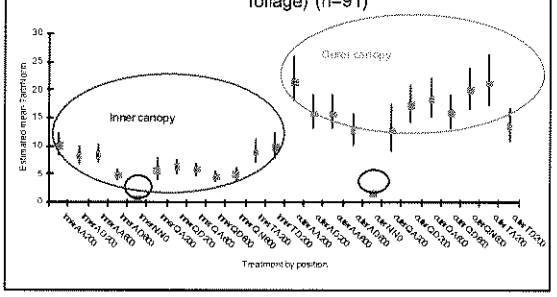


Flowering trial



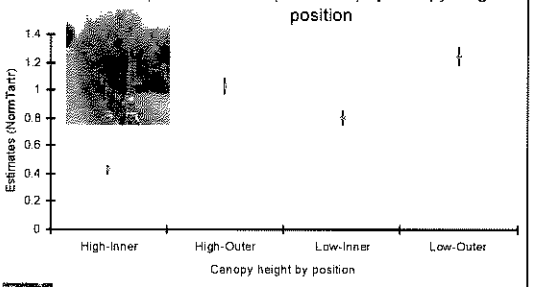
Bunch deposits at flowering

Deposit estimates (with LSI's) for comparing sprayers, volumes and adjuvants (and comparing inner and outer foliage) (n=91)

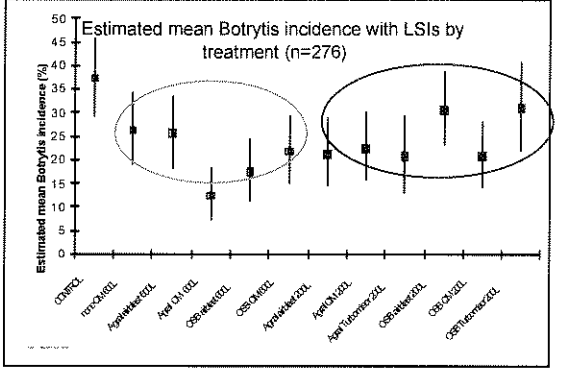


Flowering trial

Deposit estimates (with LSI's) by canopy height & position

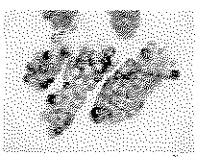


Botrytis incidence at flowering



Bunch-closure trial

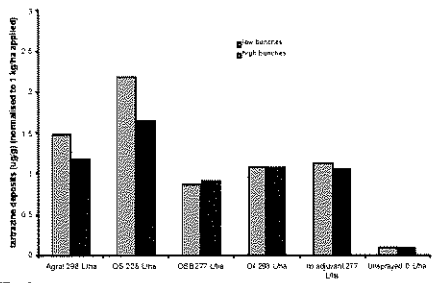
- Mildura
- January 2004
- Shiraz
- inoculated - Botrytis, downy mildew
- 6 adjuvant treatments
- Rovral and Ridomil
- only one machine



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Bunch-closure trial

Pre-bunch closure, the adjuvants performed similarly

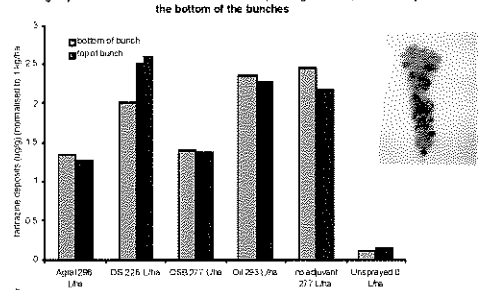


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Bunch-closure trial

Adding superwetter didn't cause losses of tracer, through run-off, from the top to the bottom of the bunches

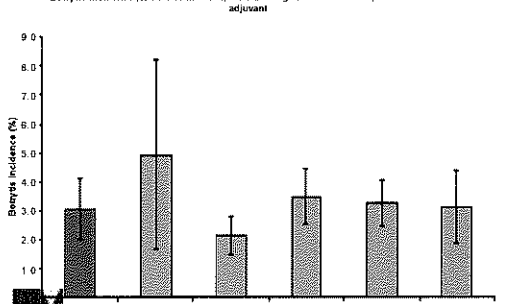


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Effect of adjuvant type on Botrytis at pre-bunch closure

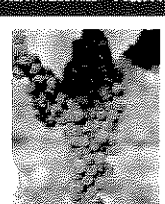
Botrytis incidence (% berries infected) after treating vines with Rovral, Ridomil and an adjuvant

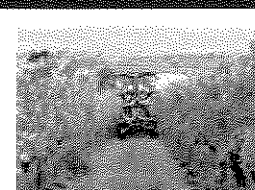


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Rain fast benefits of Bond Xtra





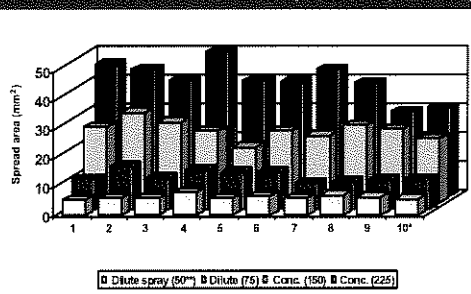
- inoculated with Botrytis
- applied Rovral plus adjuvant
- simulated +/- rain
- sampled residues day 0 and day 7



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We've seen improved spreading

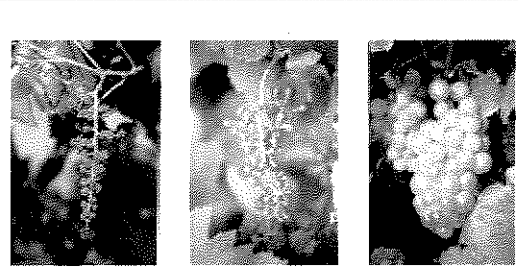


Effect of **OSB** concentration on droplet spread, on grape berries

35

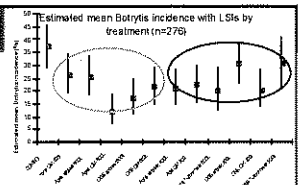
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We saw no phytotoxicity



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- Flowering
  - low and high vols provided equivalent control.
  - Canopy was a big obstacle to deposits on flowers.
- Pre-bunch closure
  - we didn't see a clear adjuvant effect
- Late season
  - we got more inside tight bunches

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Thank you



GWRDC

HortResearch PPCNZ

Curriculum Vitae

Full name: Dr David William Manktelow

Present position: Self employed research and training/extension
Present employer: Affiliated with Agribusiness Training (A PTE)
Present work address: PO Box 3415
Napier Mail Centre
Telephone +64-6 877 8786, Facsimile +64-6 844 0253
Email davidm@agribusiness.ac.nz

Academic qualifications:

B.Hort.Sc, Massey University (1983)
M.Hort.Sc (2nd class Hons, Div 1), Lincoln University (1989)
Integrated Pest and Disease Management in pipfruit.
Ph.D, Massey University (1999)
Spray application technology and disease management in pipfruit

Years as a practising researcher: 15

Honours/distinctions/membership of societies, institutions, committees:

- HortResearch Outstanding Achievement Award (1999), for development and implementation of the New Zealand Integrated Fruit Production (IFP).
- Hawkes Bay Regional Council 'Environmental Award 2000'. Presented for the development of the NZ Integrated Fruit Production (IFP) programme.
- Member of the New Zealand Plant Protection Society.

Professional positions held:

1993-2005	Scientist (pathology, application technology), HortResearch, Hawke's Bay, specialising in sustainable production systems development, agrichemical use pattern analysis and agrichemical application across a range of fruit crops. summerfruit.
1989-1993	Research Associate, MAF Technology, Hawke's Bay, working in general vegetable and fruit pathology and on decision support systems.
1989	Tutor in horticulture, Christchurch polytechnic
1986-87	Research technician, Entomology Department, Lincoln University

Present research/professional speciality:

My research since commencing a PhD in 1993 has focused mainly on pesticide application and use in apples, stonefruit and grapes. During this period I have also been involved in the development and extension of crop-based disease management systems for apples, stonefruit and winegrapes (i.e. IFP for pipfruit and stonefruit, pipfruit organics, SWNZ for grapes). The work on pesticide application and use has aimed to better match application machinery to the crop/pest to be sprayed in order to optimise spray coverage and reduce spray losses off target. I became involved in work on spray application because I perceived it to be a major weak link in current crop protection practices and that this threatened the success of low-input sustainable crop management programmes.

I have an ongoing role in analysis and reporting on industry practices through the management of data collected from industry. I am an applied researcher with strong industry associations and extension skills. I have worked in areas that I perceive to be of more or less immediate benefit to the New Zealand horticultural industry. Throughout this work I have maintained a strong interest in sustainable production systems and in research extension. I have tended to work mainly in pipfruit, but over the last five years have moved an increasing proportion of my time into work on winegrapes.

Number of refereed publications: 34
Number of patents: 0
Number of significant publications not included in the above: >50
Achievements pertinent to this proposal:

1. Selected relevant publications

Manktelow, D.W.L; Walker, J.T.S; Hodson, A.J. and Suckling, D.M. 2001. Use of industry agrochemical use data in the development of Integrated Fruit Production Programmes in the New Zealand Horticultural industry. *IOBC wprs Bulletin 24:5:51-56*

Manktelow, DWL; Walker, JTS; Beresford, RM; Hodson, AJ and Laurenson, MR 2000. Ten years in the evolution of horticultural decision support systems in New Zealand. Proceedings of the BCPC conference Pests and Diseases 1271-1278.

Manktelow, D.W.L. and Praat, J-P. 2000 Spray deposit variability in New Zealand winegrape canopies and implications for agrichemical application practices. New Zealand Plant Protection 53:235-240.

Manktelow, D.W.L. 1998. Factors affecting spray deposits and their biological affects on New Zealand apple canopies. PhD thesis, Massey University, New Zealand. 192pp.

Walker, J.T.S.; Manktelow, D.W.L.; Wearing, C.H. and Suckling, D.M. Development of Integrated Fruit Production Programmes in the New Zealand Horticultural industry . *IOBC wprs Bulletin 24:5:39-44*

Praat, J-P; Maber J.M. and Manktelow, D.W.L. 2000 Effect of canopy development and sprayer position on spray drift from a pipfruit orchard. New Zealand Plant Protection 53:241-247.

Tate, K.G.; Manktelow, D.W.L.; Walker, J.T.S. and Stiefel, H. 2000 Disease management in Hawke's Bay apple orchards converting to organic production. New Zealand Plant Protection 53:1-6.

Walker, J.T.S., Hodson, A.J., Batchelor, T.A., Manktelow, D.W.L. and Tomkins, A.R. 1997. A pesticide rating system for monitoring agrichemical inputs in New Zealand horticulture. Proceedings of the 50th N.Z. Plant Protection Society Conference 529-534.

2. Major achievements in commercial, social and environmental areas:

- I have played a lead role in IFP development in the pipfruit, summerfruit and winegrapes.
- I have lead or been a significant contributor to projects related to the practical implementation of sustainable fruit production systems in apples, winegrapes, summerfruit and citrus.
- I am involved in an ongoing series of projects aimed at developing better information management systems for fruit industries, especially where these relate to agrichemical application and use.

3. Demonstration of relationships with end-users.

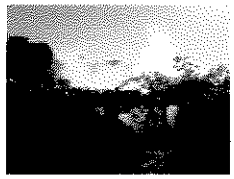
- Successful industry wide implementation of pipfruit IFP provided leadership (through the IFP committee) operated grower and consultant workshops and discussion groups.
- Preparation of disease management, spray application and agrichemical chapters for IFP manual and WallCharts. IFP assessment and review team.
- Delivered over 80 presentations, seminars, discussion groups, workshops to pifpruit, summerfruit and winegrape industries on IFP and organic fruit production in the last 5 years. Provide key advice to both organic and IFP growers on crop protection and spray application.
- Member of the SWNZ steering committee and technical subcommittee on agrichemicals.

Protecting the environment

Spray drift risks

and

drift reduction options



A New Zealand test case

- Council proposed buffer zones for spraying

  100 m with shelter, 300 m without!
- The council dropped this in favour of training
- Buffer zones appeal from green group
- Environment court hearing November 03
- The court ruling……..



Drift or overspray?

- Complaints associated with "drift" from fruit sprayers are often related to overspray
- This occurs when the spray plume is projected beyond property boundaries
- Both overspray and drift are most likely to occur in the area 10-30 m from the boundary



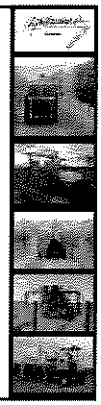
Foliage effects on spray drift potential

(Hawkes Bay apple data)

	Distance from the edge of the block (m)				
	7	15	30	90	180
	Deposits – expressed as % of applied dose/ha				
Dormant	18	5.6	1.4	0.02	0.01
Full foliage	2	0.2	0.02	0.01	0.003

A LERAP solution to drift

- LERAP = Local Environmental Risk Assessments for Pesticides
- Is an EU protocol to avoid contamination of surface waterways
- Basically LERAPs take a spray buffer zone, then define practices that allow spraying to occur within the buffer zone

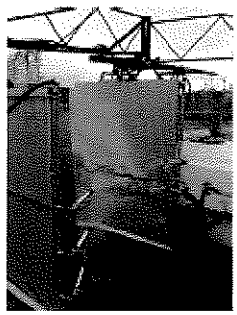


LERAP TOOLS

- Chemical choice
- Application rates
- Effective shelter belts
- Low drift sprayers
- Low drift nozzles
- Application practices on boundaries



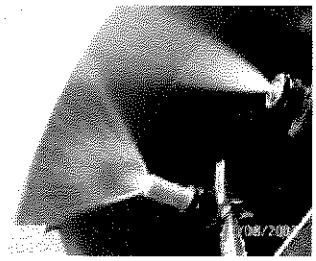
Low drift sprayer options





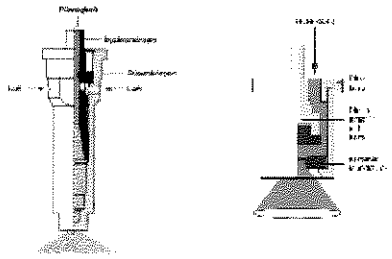


Air inclusion nozzles

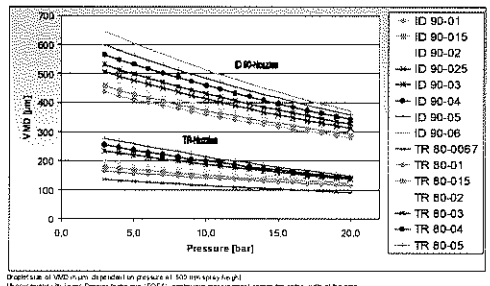




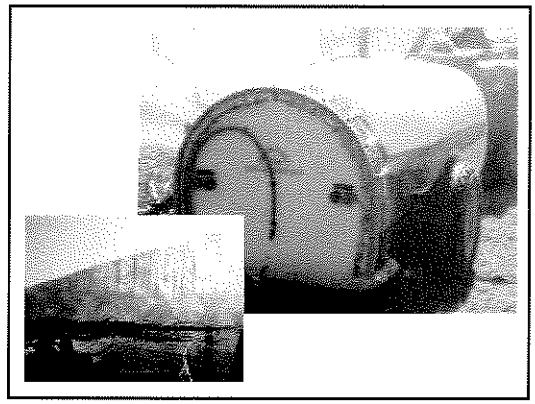
Cross sectional pictures of air inclusion versus conventional nozzles

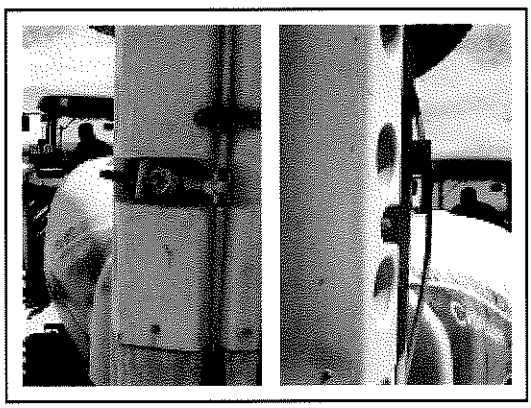


VMD of air inclusion and conventional nozzles

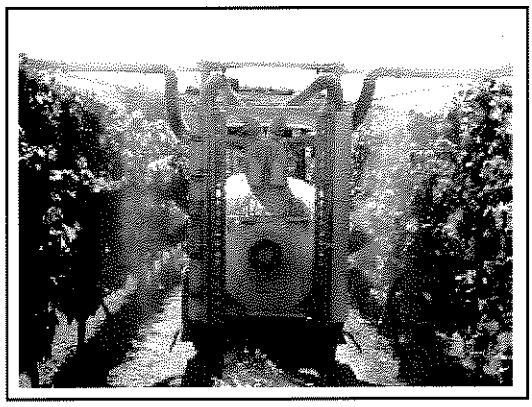


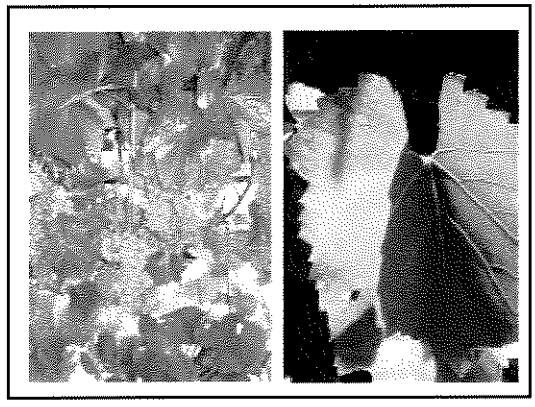


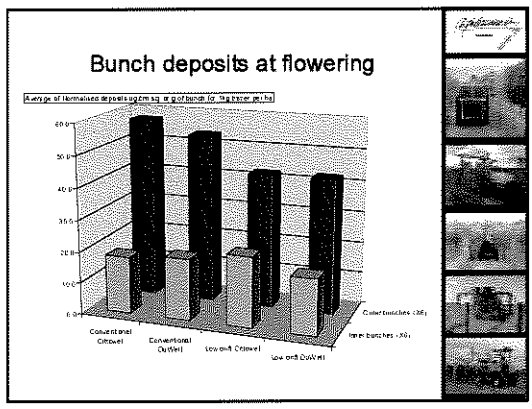


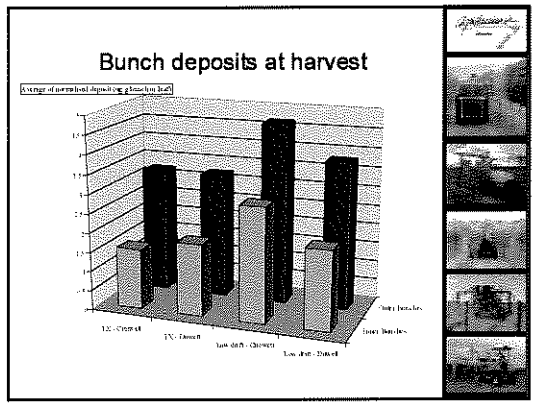




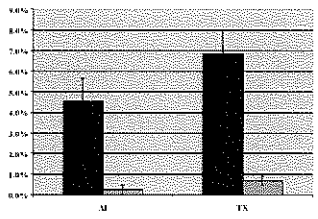




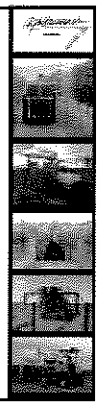

Bunch deposits at flowering
Conventional Crowell
Conventional Outfield
Low-drift Crowell
Low-drift Outfield


Bunch deposits at harvest

Preharvest Botrytis incidence TX vs AI nozzles 22/3/04

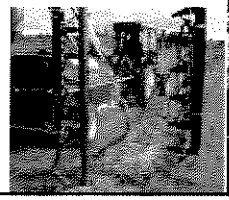


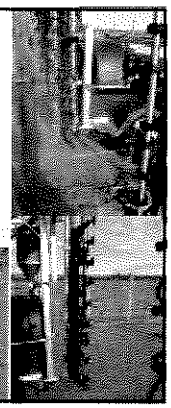
No significant difference in incidence
Severity greater with TX treatments (P=0.055)



Where to from here?

- AI nozzles appear to hold lots of potential
- They can be fitted to many sprayers
- We need to learn when they will and won't work and how best to use them





Conclusions

- Spray plume management is a key to effective pest and disease control
- Spray plume management can minimise drift risks
- Drift issues will become more important
- Practical drift management is achievable without compromising production



Conclusions

The field day was a success as attendees really appreciated having access to good speakers. The afternoon sessions really gave people confidence in adjusting their machinery and measuring coverage. Spray application is an important issue for vineyard operations from:

- an occupational health and safety viewpoint,
- from a sustainability and environment viewpoint,
- from a disease control efficacy viewpoint and
- from a trade and residue viewpoint.

The field day was a very practical hands on approach to making gains in these areas with solid reference to robust research results.

The Vineyards Association of Tasmania Technical Committee are pleased to be able to deliver the field day in co-operation with RITA Funding from the GWRDC. This is the first time VAT have accessed GWRDC funds for a field day. It enabled us to bring speakers with a detailed understanding of the topic to Tasmania and take a latest research / scientific as well as a hands on practical approach to the issue. We would like to expand on the GWRDC relationship developed with similar annual field days.