Murray Valley Winegrowers' Inc

NSW DEPARTMENT OF PRIMARY INDUSTRIES

Australian Government

Grape and Wine Research and Development Corporation

Mothballing the Vineyard – Actions & Impacts



FINAL REPORT to

GRAPE AND WINE RESEARCH & DEVELOPMENT CORPORATION

Project Number: **RT 05/01-4**

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Organisations: **Murray Valley Winegrowers' Inc. / NSW Department of Primary Industries**

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Executive Summary
Over supply was a major issue for the Australian winegrape industry in the 2005 and the 2006 vintages. The Murray Valley alone estimated that 60, 000 tonnes of fruit was harvested to the ground in the 2006 vintage, putting many growers under financial pressures and looking for ways to cut costs.

"Mothballing" quickly became a hot topic. While many growers were keen to try almost anything to cut production costs and to maintain the vineyard for future productivity / profitability, little was known about the techniques of mothballing nor the impacts implementation was likely to have on achieving future sustainability.

Murray Valley Winegrowers' Inc in co-operation with a number of other stakeholders developed a project to investigate:

1. The impacts oversupply pressures were having on Murray Valley winegrowers and,
2. To develop a number of methods for collecting information about "mothballing", that would inform growers interested in using the techniques of the potential risks involved.

"Mothballing" is defined in this project as: *"To maintain a non-producing vineyard with minimum but critical inputs to allow a rapid return to cropping for productive use / sale in the future when the industry situation has improved."*

This report gives a detailed summary of the methods used to collect information on "mothballing" and the results of the main activities which include:

1. A literature review detailing minimal input viticulture,
2. A growers survey to benchmark the changes in vineyard practice due to oversupply pressures,
3. Potential "mothballing" techniques formulated by participants in an industry forum,
4. The trial design and results of various "mothballing" techniques put into practice and,
5. The delivery of project outcomes to industry.

This project was developed in response to industry requirement, however it was well understood at the beginning of the project that time was a limiting factor in the ability to gain and deliver suitable information regarding "Mothballing" to a desperate industry.

By the 2007 vintage the need for Mothballing has decreased with a higher requirement for fruit in this season. With oversupply pressures seemingly easing, industry dismissed the need for information on mothballing techniques and impacts. The objectives of this project however were completed despite the change in industry requirement to ensure availability of practical information that could be considered to maintain a non-producing vineyard for the future, when the next market crisis occurred or with the currently diminishing water availability.

Acknowledgements are made to the initial group of stakeholders who help design the project as listed below.

Project Design:

1. Murray Valley Winegrowers' Inc. - Liz McGuire,
2. NSW DPI - Gregory Moulds, Jeremy Giddings,
3. VIC DPI - Mark Krstic, Nicole Dimos, Jeff Milne
4. Riverlink - Peter Clingleffer.

Acknowledgements are also made to April Winckel for support with data collation / interpretation as well as Anthony Baird from NSW DPI, Dareton for data collection, harvesting and sampling.

Background

In the 2005 vintage winegrape growers' were faced with the certainty of a market in over supply. Quality grown fruit left to hang on the vine or harvested on the ground was a common sight. The Australian Wine & Brandy Corporation estimated that 50,000 tonnes remained unsold in the 2005 vintage.

The 2006 Murray Valley Winegrapes for Sales Index had listings for approximately 60,000 tonnes. Much of this was not harvested and the portion that was harvested fetched unsustainable prices in the range of $150 / tonne.

As a means of survival many winegrape growers' in the Murray Valley were desperately searching for ways to cut production costs including forgoing production of varieties that were identified as being in oversupply.

Mothballing the vineyard was an idea that attracted more and more interest from growers' in these desperate times. In the 2005-06 season Murray Valley Winegrowers' Inc. ran a seminar called "What's going on?" attended by approximately 400 growers. In this seminar Industry Development Officer Liz McGuire presented a number of potential ideas on how to cut costs however, it was obvious that there was very little information available on what mothballing is, how it can be achieved and the potential consequences on future cropping potential and quality.

The term Mothballing didn't appear to be well understood and was thus defined as:

"To maintain a non-producing vineyard with minimum but critical inputs to allow a rapid return to cropping for productive use / sale in the future when the industry situation has improved."

The development of the GWRDC RITA project "Mothballing the Vineyard" aimed to gather and supply information on how to mothball a vineyard and the potential long-term effects on vineyard and business viability.

Project Objectives & Method

The objectives of this project was to investigate the practical aspects of mothballing techniques and report the outcomes to Murray Valley winegrapes to ensure the risks and consequences of mothballing the vineyard were understood.

The objectives were defined as:

1. Gather and compile relevant scientific information into a literature review relating to minimal input viticulture.
2. Conduct grower interviews throughout the Murray Valley to develop an accurate picture of how industry oversupply is affecting vineyard management practices and business viability.
3. Organise an industry forum assembling the expertise of research and industry personnel to workshop potential and practical ways for mothballing the vineyard and the potential long-term impact on vineyard productivity and profitability.
4. To develop mothballing demonstration trials for examination by growers interested in mothballing.

5. Develop an information package relating project findings and potential mothballing strategies for use by growers and potentially other regions experiencing oversupply pressures.
6. To disseminate project findings through the use of seminars.
7. To develop and maintain communication links with other wine growing regions experiencing oversupply pressures.

Discussion

This project was designed and executed in response to winegrape oversupply. A first time for the Australian winegrape industry, there was little to no information that could be collated and extended to winegrape growers. While winegrape growers needed information about "mothballing" immediately to ease the hardships of oversupply, it was obvious that implementation of methods without knowledge of the future impacts held an enormous amount of risk.

This project was run over a two year period with permission from GWRDC. Below is a description of the project outcomes.

Literature Review

A literature review was complied by Nicole Dimos from the Victorian Department of Primary Industries, see Appendix 1. This review investigated research that had been conducted on minimal input viticulture and aimed to highlight the impacts such techniques had on the vineyard and its ability to continue to produce a viable crop.

Information regarding practical application and technique impacts that could be related to the current industry situation was difficult to find, highlighting the need for specific trial work and data records.

The literature review gathered information on the following topic areas:

1. Minimal pruning,
2. Minimal water,
3. Minimal nutrition,
4. Minimal pest and disease control,
5. Crop thinning via chemical application, and,
6. Crop thinning via hand removal.

Grower Interviews

Thirty, one on one grower interviews were initially described in the project application to collect information from approximately 10% of growers who were unable to sell their fruit in the 2005/06 season according to the Murray Valley Winegrape sales index.

Due to the expectations of an increase in the potential impact of oversupply on growers in the 2006/07 season, grower interviews were converted into a survey (see Appendix 2). The survey was sent to all 1300 growers on the Murray Valley Winegrowers' Inc database to benchmark the changes growers had made in their vineyard management due to oversupply.

The survey which contained questions such as "would you grow a cover crop prior to oversupply and would you plant one in the 2006/07 season" was returned by approximately 400 growers.

The results of the survey were compiled and graphed (see Appendix 2). These results indicated that growers were indeed changing their management practices to minimise the cost of inputs and remain sustainable.

For example the results indicated that:

- Growers were going back to using basic chemicals such as sulphur for disease control,
- Disease spraying was done less often,
- Weed management became less important,
- Growers were less inclined to soil or petiole test,
- Growers were also less inclined to make any upgrades to irrigation, fertigation or irrigation scheduling equipment,
- Cover crops were removed from the management plan,
- Growers were less interested in learning about new technologies and could not afford to adopt them,
- More growers were open to the idea of mothballing patches and reducing inputs,
- The amount of money spent in the agricultural sector and the local communities was reduced.

The graphed results were reported to growers in a number of articles published in the Murray Valley Winegrowers newsletter, "The Grapevine". An example can be seen in Appendix 7.

Industry Forum

A Mothballing strategic planning forum was held in Mildura on the 16th of August 2006. Participants were invited from different sectors of viticulture categorised as industry, consultants and government. Participants were invited from different viticultural regions in Australia suffering the same hardships of oversupply.

The aim of the forum was to brainstorm potential mothballing techniques and their impacts on sustaining a viable vineyard. Using the skills of the participants, eight options were developed to potentially mothball the vineyard as listed below:

1. Chemical removal of fruit,
2. Physical removal of fruit,
3. Minimal input,
4. Severe winter pruning,
5. Cutting the vine below the cordon,
6. Removing the top cordon,
7. Irrigation stress at flowering and,
8. Zero Input.

Participants discussed the pros and cons of each technique, they considered the short and long term effects these techniques could have in the vineyard and they contemplated the time it would take to return the vineyard to a productive state.

After considering each technique, participants indicated that options 1-4 were the "best, most practical" potential techniques for mothballing the vineyard, i.e., resulting in minimal effect on the vineyards return to productivity after one season of implementation. Option 3 was seen as a technique that would be used in co-operation with most potential mothballing techniques. Options 5-8 were not seen as practical options for mothballing the vineyard, and option 8 was seen only as an approach to exit the industry, however, the group would not advocate this technique. Overall, it was clearly conveyed that these techniques should only be considered in the short-term only (one season). There was some uncertainty with specific techniques, such as the use of Ethrel to remove fruit.

Major concerns expressed by forum participants indicated that mothballing the vineyard would not provide a silver bullet answer for growers and that mothballing the vineyard could in fact cost as much to maintain a producing vineyard.

Forum participants emphasised that growers would need to assess the age of the vineyard, the health of the vines, vineyard variability, vine nutrition, pest & disease pressures before implementing any potential mothballing technique. Implementing potential mothballing techniques would be very specific to individual vineyard situations and these conditions would determine the rate of success and the time required to return the vineyard to productivity.

The industry forum provided the opportunity to collect practical information from participants that gave direction to the next section of the project which was practical application of techniques in demonstration work. A full copy of the "Mothballing Strategies Forum" report can be found in Appendix 3.

Demonstration Trial

The project application initially indicated that 10-15 observational trial sites would be developed across the Murray Valley. This plan was redeveloped taking into consideration the lack of accurate mothballing information as well as the strong warning messages that arose from the "Mothballing Strategies Forum".

Particular attention was made to the types of chemicals suggested for use as mothballing agents and the fact that they were not registered in winegrapes for this use.

Due to these reasons a site was selected on the NSW DPI Research Station at Dareton to conduct one observational demonstration trial that contained a number of different treatments and was hand harvested to eliminate any chemical residue issues.

The trial was conducted over two seasons with permission from GWRDC, with treatments applied in both the 2006/07 and the 2007/08 seasons.

Treatments used include:

1. Heavy pruning back to the cordon,
2. Calcium Nitrate sprays prior to flowering,
3. Ethrel sprays during flowering,
4. Gibberellic Acid,
5. Sulphur plus oil.

Treatments were exposed to different water availability and rootstock impacts which provided some insight into the variety of factors that would affect the time to return to full production and the impact implementing such techniques would have on business viability.

Field walk exercises were developed and run as part of this project section, however due to a change in industry circumstances, interest was minimal. A number of one on one visit were conducted with growers and persons with specific mothballing interest.

The trial at Dareton was developed in collaboration with SARDI Research Scientist John Croker who ran similar trials in South Australia. Where possible treatments and application times were duplicated and results discussed.

A full copy of the trial report, including photos can be viewed in Appendix 4.

Mothballing Publication

The Mothballing publication is a simple four page pamphlet that describes what "mothballing" is and potential techniques for mothballing the vineyard as examined in the demonstration trial.

This publication does not describe the steps to implementing mothballing management strategies as was initially expressed in the project application. The reason for this change is mainly due to the use of chemicals that were not registered for mothballing purposes in winegrapes and therefore could not be recommended.

The Mothballing publication which can be viewed in Appendix 5, gives a brief overview of the findings of the demonstration trial combined with a warning to investigate before implementation.

The document contains photos of the different treatments and a check list designed to assist growers collect relevant information before implementing mothballing changes to vineyard management practices that could negatively impact future vineyard viability.

This document was made available to growers on request, however due to the changes in industry oversupply status interest was low.

Extension of Project Findings

While the pressures of oversupply declined a relatively short period after this project started, changing growers' interest in mothballing, the results of this project have been extended using the following methods:

Literature Review

The Literature review was made available to growers in hard copy upon request and was available for download on the Murray Valley Winegrowers' website www.murrayvalleywinegrapes.com.au .

Little interest has been shown in the literature review.

Grower Interviews

The results of the survey benchmarking the changes due to oversupply were periodically printed in the Murray Valley Winegrowers' newsletter "The Grapevine".

Examples of the results can be viewed in Appendix 7.

While the pressures of oversupply have declined, the trends seen due to these pressures have continued due to drought, low water availability and most recently the increases in fertiliser input costs.

Demonstration Trial

Progress updates of the trial results were detailed in a number of articles printed in the Murray Valley Winegrowers' newsletter "The Grapevine", an example is listed in Appendix 7.

The Murray Valley Viticulture Technical group toured the mothballing demonstration site in the 2006/07 season. This field walk was met with interest from participants and provided the project organisers a alternative method of extending the project results via communication with the technical groups individual stakeholder groups. The use of this group to extend project results to a larger audience lead to a number of grower enquires and one on one field visits.

A tour of the demonstration trial was organised for Murray Valley winegrowers in November 2007, however it was cancelled due to low interest.

While the interest in mothballing as a solution for oversupply pressures declined due to a change in industry circumstances, the information gained from the demonstration trial

could potentially be used in relations to sustaining vineyard viability under low water availability.

Mothballing publication
This publication was made available to growers on request and was available on the Murray Valley Winegrowers' website www.murrayvalleywinegrapes.com.au for download.

There has to date been minimal response to this document, however it does contain basic information that could be considered for vineyard sustainability under low water availability.

Australian Winegrape communication
Communication links were formed with industry and government representatives in winegrape growing regions across Australia who were experiencing the same hardships of oversupply. Representatives from these winegrowing regions were invited to attend the Strategies forum for input into the project.

Regions invited attend the forum and participate in the development of oversupply coping strategies include: South Australian winegrowing regions (including the Riverland, Coonawarra and the Barossa Valley), the Riverina, Queensland winegrowing regions, Western Australia winegrowing regions, the Greater Victoria regions including the Grampians and the King Valley, Tasmanian winegrowing regions, central New South Wales winegrowing regions.

Communication with relevant parties regarding mothballing continued until oversupply issues eased.

Communication with SARDI regarding a similar mothballing project continued for the duration of the project.

Conclusion
This project was developed in response to the hardships suffered by growers in times of oversupply and the lack of information regarding techniques that could be used to sustain viable non-producing vineyards for future production.

While the pressures of oversupply declined and growers / industry became less interested in mothballing, the outcomes of the project could potentially have practical application in light of new industry pressures, including low water availability and rising input costs.

This project successfully achieved the aim of collecting and compiling information that will be available when required to growers and industry investigating the best methods to mothball a vineyard.

APPENDIX 1 – Literature Review

Mothballing Review - 2006

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Introduction:

Grape growers are constantly faced with challenges, from environmental constraints such as water restrictions and climatic pressures to the ever increasing rise in production costs. Recently they have been faced by a new challenge, coping with the excess in wine store and a decreased demand for fruit.

The Australian Wine & Brandy Corporation estimated that 50,000 tonnes remained unsold in the 2005 vintage. In 2006, the Murray Valley wine producing region alone had listings for approximately 60,000 tonnes of unsold fruit. These figures were eminent elsewhere in the nation, with all major production regions unable to sell fruit at sustainable prices, or at all. Quality grown fruit left to hang on the vine or harvested on the ground was a common sight.

Growers were required to be more than 'just a farmer' but sound and economic business managers. They were also required to seek alternative management options to reduce the cost of production under uncertain circumstances.

The term Mothballing is not well understood. In this review Mothballing will be defined as:

"To maintain a non-producing vineyard with minimum but critical inputs to allow a rapid return to cropping for productive use / sale in the future when the industry situation has improved."

Viticultural research does not generally investigate the combined effects of minimal input production systems, this has left the industry guessing at the potential side effects it could have on future cropping potential, production and fruit quality, and thus information transfers back to the wine grape growing communities.

The aim of this review is to provide a snapshot to the scientific research conducted on minimal input viticulture in attempt to expose their impacts, although there is no specific research on "mothballing" as a whole. Another limitation to the research information available is that seldom are crops retained on the vine and thus we have no factual

evidence of the potential effects abandoned fruit has in future production seasons when supply is sought.

It's not surprising that growers are now interested in knowing how little inputs are really required. The four major production costs include pruning, irrigation, nutrition and pest and disease management, but how little of these essential inputs can growers commit without detrimental effects in the vine, and how long will it take for the vine to return to "normal" yielding capacity. There is an abundance of literature investigating these impacts, but unfortunately, each of these practices have been investigated alone, so the interactive effects may lead to discrepancies in our analysis or interpretation. As with many research projects, data is generally only presenting the outcomes from short-term projects, not the long term impacts of implementing mothballing techniques. Following is an account of minimal input techniques and there various effects on production.

Minimal Pruning

Minimal pruning is not a new concept. Research dates back to the 1930s when Winkler conducted trials and concluded if managed correctly, vines could exhibit great production capacity (Winkler, 1974). However, in time of oversupply, the impacts of minimal pruning, although economically efficient to the grapegrower, may cause further detriment in terms of increased yields as a result from excess shoots and excessive bunch number even though these bunches are lighter, and thus extra post set management is required.

Lakso (1999) summarised the physiological effects of minimal pruning and compared this with conventional pruning of Concord grapes. He found that over a nine year period, there was no yield differences over time with the minimally pruning technique, sustaining 20% higher yields than conventional pruning, however, berry size and TSS were reduced because of these heavier crops.

Clingeleffer 1984 on Sultana vines left unpruned but skirted (minimally pruned) for six years showed that when compared to traditional pruning methods (hand), limits production. Minimal pruning increased production of 50 year old vines over six seasons by 60%. They had more bunches, more shoots, but fewer bunches per shoot and smaller bunches, however, the number of bunches significantly outnumbered this effect, (106 bunches compared to 43). At harvest, minimal pruned vines had a canopy similar in size to the control (hand pruned vines) yet this smaller leaf to fruit ratio still matured the crop. Minimal pruned vines developed into larger vines because only 15% of the wood was

removed at pruning compared to 85% from the control. Minimal pruned vines could be both hand and mechanically harvested. This latter is important because it allows growers an option to save money on harvesting costs.

Yields were also increased in own-rooted Chancellor vines from minimally pruned and hedged vines compared to manually pruned vines. However, as reported by others above, cluster weights, berries per cluster and berry weights were lower. Minimal pruning resulted in fruit with lowest Brix, followed by hedged vines. There was also a reported decrease in TA and pH in the minimally pruned vines. The authors suggest that quality is impeded by the reduced pruning styles and suggest crop thinning to alleviate this problem (Reynolds and Wardle, 2001).

In a two year study, Striegler and colleagues (2002) investigated the effects of four pruning systems ranging from severe hand pruning (60-80 nodes/vine) to minimal pruning (200-400 nodes/vine) and vines were not treated with any form of chemical applications for pest and disease control. Yield components and juice quality was assessed. Minimally pruned vines had the highest cluster/vine and lowest cluster weights. The high yields obtained were less mature, resulting in juice with lower soluble solids in the first season, however, in the second season of the study, these outcomes were reversed. Sensory analysis showed that the minimal pruned and severe hand pruned vines were preferred over the machine pruned or moderate pruned hand vines for juice sweetness and colour intensity by the second season of the study. No discussion regarding disease impacts were discussed, and thus assumed to be unaffected.

Hedging to the 9-10th node was conducted either one week or five weeks after flowering on 10-year old field vines in Italy. Five commonly grown cultivars were used in the experiment. The vines hedged one week post-flowering resulted in enhanced yield and grape composition, by allowing good exposure, and generally increased laterals were produced. However, the vines hedge to the same intensity but at five weeks after flowering lead to decreased yields, TSS, anthocyanin levels, nitrogen content and polyphenol content of the fruit at harvest (Cartechini *et al*., 2000). The positive results obtained with early hedging are most likely linked to;

1. enhance light availability, thus increase photosynthetic activity
2. improved air circulation and lower relative air humidity in the canopy
3. increased pesticide penetration into canopies and reduced Botrytis and other grapevines diseases
4. enhanced activity of key ripening enzymes.

Minimal pruning and interaction effects

In a study directed towards improving fruit quality, Weynard and Schultz (2005) concluded that together with GA_3 application applied to Riesling field vines at flowering may assist minimal pruned vines to reduce yields whilst maintain small berries and loose cluster structure through their influence on bud fertility and flower number per cluster the following season. In the first year of the study, GA_3 when applied at 50 ppm at a rate of 500 L/ha, both yield and must quality decreased, however, by year two, yield decreased further, yet, wine quality increased. The decrease in yield was attributed to a decrease in cluster number and not shoot number.

Ruhl and Clingeleffer (1993) found that minimal pruning Cabernet franc vines resulted in reduce nitrogen accumulation in the perennial vine parts, particularly the roots and canes, compared to that of spur pruned vines. Thus, together with reduced fertiliser application, the effects would be magnified. Clingeleffer and Krake (1992) also report in these same pruning style vines, minimal prune cordon trained had more than double the number of shoots which had fewer and more closely spaced nodes. When comparing total vine size between spur pruned vines and minimally pruned cordon trained spur vines, there was no differences. Virus disease effects were also amplified with the minimal pruned system, with yield loses as great as 20% depending of inocula. Berry size was reduced by 30% with minimal pruned vines. Yield was not different compared to spur pruned vines.

Minimal Water

A common treatment in irrigation research is to investigate extremes in water use, that is, 100% field capacity compared to reduced quantities, and also investigations into the effects of water deficits at key phenological stages of development, and their impacts on yield and quality.

The water status of the grapevine strongly affects berry size (Smart *et al*., 1974; Matthews *et al*., 1987; McCarthy, 1997). Water deficits between flowering and veraison decrease berry size, which is often irreversible even if there is no water shortage after the beginning of ripening (Matthews *et al*., 1987; McCarthy, 1997, 2000). Yield reduction was apparently related to reduced berry weight. Van Zyl (1984) found that re-application of water to field grown Colombard vines that were water stressed between flowering and the beginning of the lag phase did not result in an increase in berry weight at harvest.

Shiraz vines growing in the MIA (NSW) had an applied water stress up to veraison. This resulted in a significantly reduced berry size, the yield component most sensitive to water stress (Smart *et al*., 1974), even though well irrigated after veraison did not result in berry/vine recovery. Hardie and Considine (1976) also reported yield reductions to container grown Cabernet Franc vines in response to severe water stress, with the greatest losses observed in stress applied in the three weeks post flowering, and most likely due to reduced fruitset. Maturity was also delayed, especially when stress was applied later. Elsewhere, it has been shown that during the ripening period (Stage III), the size of stressed berries recovers partially, if not totally, if water is available, to varieties such as Colombard (Van Zyl, 1984) Concord (Poni *et al*., 1994) and Shiraz (McCarthy, 1997). In summary, final berry size appears to be influenced more by water deficits between flowering and veraison than between veraison and maturity.

Irrigation and interaction effects

Freeman *et al*., (1990) found that irrigation compared to no irrigation and pruning to a high node number (160 nodes) compared to a low node number (20 nodes) both delayed sugar accumulation (by about 2 weeks) due to an increase in yield and increased total sugar production. In some years, severe pruning together with irrigation hastened sugar accumulation and in others delayed ripening compared to non-irrigated vines although yield levels were similar. Acidity and pH of juice was lower in non-irrigated vines, with juice acidity decreasing during fermentation.

Hepner *et al*., (1985) investigated Cabernet Sauvignon under four irrigation quantities. These ranged from 220mm to 400mm applied at weekly or fortnightly intervals. Seasonal water application in the range of 220 to 320mm did not have a considerable effect on wine quality, whereas 400mm caused a significant quality reduction. Irrigation cutback during the last six weeks before harvest in which 50% of irrigation was applied, advanced ripening, but was not connected to improved quality in 3 of the treatments. However, vegetative growth was reduced. Many of the changes seen in the experiment were noticeable by year four in this five year trial. Therefore, short-term production deficits appear to have no effect of yield and fruit quality. Furthermore, (Bravdo *et al*., 1985), using the same field conditions, vines were further segregated into thinning treatments, where 65, 40 or 20 bunches were retained per vine. The results implied that water uptake could be increased by restricted irrigation, intensive vegetative growth and low crop load, especially when an extensive root system already existed.

Minimal Nutrition

Considered one of the highest costs in vine production, how much nutrition do vines needs, and which are the essential elements required. Currently, nitrogen is the most commonly used mineral input, particular in the warm-irrigated regions of winegrape growing. Its use to increase yields and vine vigour are undeniably understood.

In a three year trial on White Muscat/Kober 5BB field vines, nitrogen was applied as ammonium sulphate in a single spring application of one of four rates; 0, 40, 80 and 160 kg ha-1 (Gay *et al*., 2000). A number of parameters including yield, bunch number and mass, berry mass, Botrytis bunch rot, TSS, pH, TA, pruning wood, leaf nutrient status were obtained. Botrytis damage was more severe in the grapes fertilised with 160 kg ha-1 than with the 40 kg ha-1 or zero N application. Differences in yield and vigour were small and not significant in the first two years. In the third year, canopy differences were evident at the highest N rates, whilst grape ripening was delayed as shown by Brix / acidity ratio decreasing from 2.19 (0 N) to 1.45 (160 N).

In a four-year study comparing irrigation, pruning severity and nitrogen levels, Morris and colleagues (1983) reported that there was little effect on yield and pruning weight due to the nitrogen treatment, although TSS and colour were lower in the low N vines.

Treeby *et al*., (1996) in a field trial on Shiraz in Sunraysia looked at varying N fertiliser application rates, on the wine grape composition. Nitrogen (N) was applied at either summer or post-harvest at a rate of 40 kg N/ha, in a split rate, or at 80 kg N ha in a split rate compared to a control receiving no N fertilisation. One week prior to harvest, bunches were collected and composition evaluated. The results showed that those vines receiving either no or 80 kg N ha had lower colour and total phenolic on a fresh weight basis, than those receiving 40 kg N ha regardless of application timing. In the wines, colour density was highest in wines made from grapes off vines not receiving N and receiving N only in the summer, the lowest was the 80kg N ha treatment with colour hue, representing the reverse order. Total anthocyanins were lowest in wines made from grapes off vines receiving 40 kg N ha post-harvest or split or 80 kg N ha. The length of fermentation strongly influenced the levels of total phenolic in the final wine, a similar trend to the berry patterns. Extremes in N supply resulted in grapes of lower quality, but juice N possibly by the role it plays in fermentation was a major factor in determining the quality of the final product. Thus, by appropriate management of N supply in the vineyard it appears possible

to balance grape growers needs for high productivity, the winemakers need for unimpeded fermentation and the consumers desire for full coloured red wine.

Minimal Pest and Disease control

In warm irrigated regions, the benefits of our generally hot weather appear to be unfavourable for pest and disease outbreaks. However, the biggest culprits are fungal infections namely powdery and downy mildew (especially if rain occurs).

In a 4-year investigation on field grown Concord vines, Gadoury *et al*., (2001) to determine the effects of powdery mildew on vine growth, yield and quality on vines grown at three cropping intensities, vines were either routinely sprayed with a fungicide to protect from fungus attack or inoculated with spores and left unsprayed. Failure to control powdery mildew resulted in chronic reduction in wood maturity measurements as the number of nodes on canes that developed periderm. The reduction in nodes did not reduce yields, possibly due to compensation in shoots produced from the remaining nodes. Powdery mildew did not affect bud survival or vigour, measured as the number of shoots produced per node on retained canes. The most significant effects of powdery mildew were on berry sugar levels, juice colour and acidity, which on unsprayed vines were sometimes reduced below minimally acceptable thresholds for processed grapes. This occurred in all pruning treatments, but was most pronounced at higher cropping levels.

Crop thinning via chemical application

Crop thinning is a method that may be implemented to reduce crop loads in winegrapes. It has previously been used with success in the dried vine and table grape industries. These industries have trialled a number of chemical amendments to thin the crop such as ammonium nitrate (Mollah and Krstic, 2000 and Zabadal *et al.,* 1997), copper sulphate (Zabadal *et al.,* 1997), potassium iodine (Weaver and Pool 1971a,b), potassium carbonate, potassium hydroxide and urea (Mollah and Krstic 2000). The use of hormones has also been applied to thin grape crops. More recently, ethylene based products such as ethephon (Ethrel) has been used.

In crop thinning experiments, Zabadal *et. al.* (1997) trialled ammonium nitrate at 120 and 750 g/L at four growth stages for fruit removal with increased effectiveness with later applications. Late applications (at shoot length of 30 cm) using ammonium nitrate (120 g/L) were considered to have the optimum thinning effect if applied to 14 % of the vine. In

this experiment copper sulphate (7.5 g /L) was also evaluated on 30 cm long shoots with a similar result to ammonium nitrate (Zabadal *et. al*. 1997). Potassium iodine was used as a thinning agent by Weaver and Pool (1971a,b) on Thomson seedless with a greater than 90% thinning rate achieved at pre-bloom and bloom. Mollah and Krstic (2000) evaluated the effectiveness of ammonium nitrate, potassium carbonate potassium hyrdroxide and urea on Sultana and Carina cordon bunches. Ammonium nitrate was considered to be the most effective at the rate of 2.5% applied when 9 leaves are fully separated and 3% at 13 separated leaves. Urea was found not to cause relative fast (1-4 days) necrosis of the fruit as observed with other fertilisers but the fruit loss occurred over 2-3 weeks. The action of urea in thinning of berries are unlike that of any other fertiliser or published results of urea toxicity in leaves. This delay reaction could be a unique response of grape berries to urea or ammonium poisoning or the high levels of urea are acting as a protein denaturant and enzyme inhibitor (Engel 1977).

There has been extensive research to the use of Ethephon in viticulture, and this has been reviewed by Szyjewicz *et al*., (1984) in which the hypotheses concerning its interaction with endogenous hormones have been proposed. To varying degrees, it influences colour development, fruit maturity and composition, abscission, vegetative growth, buds, propagation, seeds and sensory characteristics of grapes and wine. Numerous factors including cultivar, concentration, timing, method of application, pH, adjuvants, temperature and vine water status all influence the grapevines response to ethephon, which have all been discussed in this published review. Unfortunately, the majority of the literature focussed on this product is used in investigations of colour development and ripening in the table grape industry.

Szyjewicz and Kliewer (1983) investigated the use of a single application of 750ppm ethephon (Ethrel) at nine different stages of development on field grown Chenin blanc grapevines. The first treatment began at full flowering, with eight subsequent treatments sprayed at one week intervals following flowering. Results were compared to unsprayed control. Overall yield, primary crop yield, and number of primary clusters were significantly reduced in vines treated with ethephon within 3 weeks post flowering, where whole bunches were abscised, a result similarly reported by Mannini *et al*., (1981) and Weaver and Pool (1971b), however, contradictory results are presented in fruit composition results. The authors in this study reported a reduced TSS and pH and increased TA in fruit at harvest from the vines sprayed early and exhibiting these yield reduction, which to the contrary to the work of Jensen *et al*., (1980); Singh and Chundawat (1978); Weaver and Pool (1971a) and Weaver and Montgomery (1974) who reported

either increases in TSS or decreases in TA even those the yield results are similar. The results clearly show that ethephon reduces crop yields if the growth regulator is applied at a proper physiological stage of berry development.

Nir and Lavee (1981) applied ethephon to different organs of both detached and intact shoots of one year old greenhouse grown grapevine cultivars Perlette and Cardinal. Recovery of ^{14}C-labelled compounds, 48 hours after application indoors to detached leaves was only 5%, even though 20% of the ethephon applied penetrated the plant tissue. Thus, transport to the plant is very slow. The ethephon did not translocate to the sink regions of the vine, for example fruit, shoot tip, as typically assumed with phloem transport. However, when applied to the growing tip (Hirschfeld, 1979) growth was inhibited.

Mannini *et al*., (1981) applied ethephon at the early flowering stage to mature Zinfandel grapes at 1000 ppm to the top of vine, 300 ppm to fruit area, 1000 ppm to topped vines. The vine topping treatment reduced the weight and volume relative to the other two treatments. This treatment also reduced the pruning weights compared to the 300 ppm treatment only. This later treatment (fruit only sprayed) had significantly higher TSS, but not significantly higher yields. This is unlike the effect of the treatment where ethephon was applied to the top of the vine where a yield decrease was observed.

Weaver and Pool (1971a) found that ethephon when applied to Thompson Seedless and Carignane at a rate of 3000 ppm at pre-bloom or bloom caused curling of shoot tips and development of abscission layers at the apical nodes. Ethephon reduced the crop on Thompson Seedless at all concentrations (ranging form 30 ppm to 3000 ppm); with the lowest concentration most effective at pre-bloom and caused a delayed budbreak in the following season. With Carignane, fruitset was reduced by all treatments except when sprayed after that time, however, for effectiveness proper timing and concentration must be determined for different cultivars.

The effectiveness of ethrel as a thinning chemical for Muscat of Alexandria grape was examined with various timings and concentrations of application. Ethrel applied at 50 mg/L by cluster dipping or shoot spraying at full flowering or 6 days-post-flowering, resulted in over-thinning and chemical injury, and no thinning effect was found when ethrel was applied at 5 or 10 mg/L on these same dates or at 12-days post flowering.

There is an abundance of research in to table grape practices in which GA is used to firstly increased ‘shatter’ or decrease berry number followed by subsequent sprays at fruit set to

increase berry size. Described as early as 1974 by Winkler in his reclaimed viticulture textbook, the known affects of GA sprays to reduce number of berries is well understood, particularly in the table grape industry. Dokoozlian and Hirschfelt (1995) have more recently worked in this in the US Table grape industry and Ben-Tal in Israel (1995), and have reported the practicalities of timing of cluster removal. They suggest that thinning prior to flowering and prior to extensive canopy development is optimal because the fruit is attainable and easily identified in the vineyard, however the risks too are great as berry set and cluster size is known at this time. This can result is consequential yield impacts should the winegrape grower find a home for fruit later in the season and yield availability is severely depressed. The effects of GA treatments in wine grapes are relatively unknown.

Crop thinning via hand removal

Morris *et al*., (2004) looked at either flower thinning by hand or shoot thinning (to the level attained by a known flower number removal). Thinning treatments had little effect on bunch or berry weights, or berry composition. Shoot thinning decreased yields consistently, (cluster number) for all cultivars investigated, but flower cluster thinning affect only red cultivars it would offer a viable approach to achieving balance between growth and fruiting. The effects of thinning method and shoot position on fruit composition varied with cultivar. These preliminary data indicate that crop control of the cultivars studied can be accomplished by flower cluster thinning and shoot thinning however, the response to thinning varies with cultivar.

In a five year trial of three popular winegrape cultivars, Keller *et al*., (2005) investigated the effects of cluster thinning either at one month post flowering or at veraison on deficit irrigation vines. The results describe that on average over time, removing between 30-40% of bunches had no influence on vegetative growth, but reduced yields by about 35% in red varieties and 20% in white varieties. There were no reportable disadvantageous effects in terms of vine balance, vigour, fruit composition, therefore, the impacts of this treatment appear minimal and the vine can return to a productive state rapidly. It is unclear whether these results would be maintained/consistent had fruit removal been performed earlier or greater levels of fruit removed.

Holzapfel *et al*., (2006) reported that vine productivity was considerably changed by manipulating the post-harvest period in the previous year. An extended period (early crop removal) stimulated vigour and yield formation in the subsequent season, while shortening the assimilation period after harvest (leaf removal at harvest) had the opposite effect. Fruit

ripening was delayed by crop removal in the previous season in the warm-irrigated regions where the study was conducted. This has important implications for the sustained management of grapevines in attempt to produce consistent high yields.

Vines of cultivar Sangiovase, Merlot and Cabernet Sauvignon grown in vineyards were thinned at three levels (0%, 20% and 40%) just before veraison eliminating all distal clusters for three consecutive years. In all cultivars, the cluster thinning significantly reduced the yield in the 40% intensity level. The reduction of yield observed was not proportional to the cluster thinning intensity due to significant increases of berry and cluster weight. Decreasing yield caused earlier ripening, increase pH and TSS, anthocyanins, polyphenols and total nitrogen in the must. By year two, the percentage of clusters affected with more than 5% incidence of *Botrytis cinera* was reduced above all in 40% thinned vines (Palliotti and Cartechini, 2000).

Crop thinning subsequent to fruitset can help regulate yield and improve fruit composition at harvest. The study investigated the effects of crop removal after fruitset (when berries were pea size) using a machine harvester in Sunraysia. Specific zones of the canopy were targeted for thinning to remove a predetermined percentage of the fruit and avoid over-thinning. The responses were compared to mechanical machine thinning with control (un-thinned vines) and hand thinned vines, where the same proportion of fruit was removed as the machine. The reasoning for the machine thinned treatment was to assess the damage to fruit and foliage and reduced yield. Both thinning treatments successfully reduced yield, advance fruit maturity (TSS at harvest) Berry weight, as too anthocyanin was increased by thinning, thus, mechanical thinning successfully reduced crop level to the target yield, and improved fruit quality. Regulation of yield across large areas of vines quickly and cost effectively is offered here as minimal damage was seen to the vines (Petrie and Clingeleffer, 2006).

Conclusion

Mothballing is not an area that has had extensive research, however under circumstances of oversupply, reduced water availability, unsustainable returns and rising input costs it is attracting more interest and requires further scientific investigation to reduce the risks associated with techniques and ensure the opportunity to return the vineyard to a productive state.

Reference list

Ben-Tal Y 1995. Effects of gibberellin treatments on ripening and berry drop from Thompson seedless grapes, *American Journal of Enology and Viticulture*, **41(2)**, 142-146.

Bravdo B, Hepner Y, Loinger C, Cohen S and Tabacman H 1985. Effect of irrigation and crop level on growth, yield and wine quality of Cabernet Sauvignon, *American Journal of Enology and Viticulture*, **36(2)**, 132-139.

Cartechini A, Palliotti A and Lungarotti C 2000. Influence of timing of hedging on yield and grape quality in some red and white grapevine cultivars, Proc XXV IHC – Part 2 (eds Possingham and Neilsen) *Acta Horticulturae*, **512**, 101-110.

Clingeleffer PR 1984. Production and growth of minimal pruned Sultana vines, *Vitis*, **23**, 42-54.

Clingeleffer PR and Krake LR 1992. Responses of Cabernet franc grapevines to minmal pruning and virus infection, *American Journal of Enology and Viticulture*, **43(1)**, 31-37.

Dokoozlian NK and Hirschfelt DJ 1995. The influence of cluster thinning at various stages of fruit development on Flame seedless table grapes, *American Journal of Enology and Viticulture*, **46(4)**, 429-436.

Engel PC 1977. Enzyme kinetics, John Wiley and Sons, New York.

Freeman BM, Lee TH and Turkington CR 1980. Interaction of irrigation and pruning levels on grape and wine quality of Shiraz vines, *American Journal of Enology and Viticulture*, **31(2)**, 124-135.

Gadoury DM, Seem RC, Pearson RC, Wilcox WF and Dunst RM 2001. Effects of powdery mildew on vine growth, yield and quality of Concord grapes, *Plant Disease*, **85(2)**, 137-140.

Gay GE, Morando A, Lovisolo C and Bovio M, 2000. Nitrogen effects on yield and canopy of 'White Muscat' grapevines, *Acta Horticulturae*, **512**, 47-54.

Hardie WJ and Considine JA 1976. Response of grapes to water-deficit stress in particular stages of development, *American Journal of Enology and Viticulture*, **27(2)**, 55-61.

Hepner Y, Bravdo B, Loinger C, Cohen S and Tabacman H 1985. Effect of drip irrigation schedules on growth, yield, must composition and wine quality of Cabernet Sauvignon, *American Journal of Enology and Viticulture*, **36(1)**, 77-85.

Holzapfel BP, Smith JP, Mandel RM and Keller M 2006. Manipulating the postharvest period and its impact on vine productivity of Semillon grapevines, *American Journal of Enology and Viticulture*, **57(2)**, 148-157.

Jensen F, Christensen P, Andris H, Swanson F, Leavitt G and Peacock WL 1980. The effects of ethephon on Thompson Seedless grapes and raisins, *American Journal of Enology and Viticulture*, **31**, 257-260.

Keller M, Mills LJ, Wample L and Spayd SE 2005. Cluster thinning effects on three deficit-irrigated *Vitis Vinifera* cultivars, *American Journal of Enology and Viticulture*, **56(2)**, 91-103.

Lakso AN 1999. Physiology of minimal versus normal pruning of Concord grapes. Proceedings of the Michigan State Horticultural Society.

Mannini F, Weaver RJ and Johnson JO 1981. Effects of early bloom sprays of ethephon on irrigated and nonirrigated vines of Zinfandel grapes, *American Journal of Enology and Viticulture*, **32(4)**, 277-279.

Matthews MA, Anderson AA and Schultz HR 1987, Phenologic and growth responses to early and late season water deficits in Cabernet franc, *Vitis*, **26**, 147-160.

McCarthy M 1997, The effect of transient water deficit on berry development of cv. Shiraz (*Vitis vinifera* L.), *Australian Journal of Grape and Wine Research*, **3**, 102-108.

McCarthy MG 2000. Developmental variation in sensitivity of Vitis Vinifera L. (Shiraz) berries to soil water deficit, *Australian Journal Grape and Wine Research*, **6**, 136-140.

Mollah M and Krstic M 2000. Adoption of mechanised dried vine fruit production systems, DFRDC, Mildura.

Morris JR, Spayd SE and Cawthon DL, 1983. Effects of Irrigation, Pruning severity and nitrogen levels on yield and juice quality of Concord grapes, *American Journal of Enology and Viticulture*, **34(4)**, 229-233.

Morris JR, Main GL and Oswald OL 2004. Flower cluster and shoot thinning for crop control in French-American hybrid grapes, *American Journal of Enology and Viticulture*, **55(4)**, 423-426.

Nir G and Lavee S 1981. Persistence, Uptake and Translocation of [^{14}C]ethephon (2-chloroethyl phosphonic acid) in Perlette and Cardinal grapevines, *Australian Journal Plant Physiology*, **8**, 57-63.

Palliotti A and Cartechini A 2000. Cluster thinning effects on yield and grape composition in different grapevine cultivars, Proc XXV IHC – Part 2 (eds Possingham and Neilsen) *Acta Horticulturae*, **512**, 111-119.

Petrie PR and Clingeleffer PR 2006. Crop thinning (hand versus mechanical), grape maturity and anthocyanin concentration: outcomes from irrigated Cabernet Sauvignon (*Vitis Vinifera* L.) in a warm climate, *Australian Journal Grape and Wine Research*, **12**, 21-29.

Poni S, Lakso AN, Turner JR and Melious RE 1994, Interactions of crop level and late season water stress on growth and physiology of field-grown Concord grapevines. *American Journal of Enology and Viticulture*, **45**, 252-258.

Reynolds AG and Wardle DA 2001. Evaluation of minimal pruning upon vine performance and berry composition of Chancellor, *American Journal of Enology and Viticulture*, **52(1)**, 45-48.

Ruhl EH and Clingeleffer PR 1993. Effect of minimal pruning and virus inoculation on the carbohydrate and nitrogen accumulation in Cabernet franc vines, *American Journal of Enology and Viticulture*, **44(1)**, 81-85.

Singh IS and Chundawat BS 1978. Effect of ethephon on ripening of 'Delight' grapes, *HortScience*, **13**, 251.

Smart *RE, Turkington CR and Evans JC* 1974. Grapevine response to furrow and trickle irrigation, *American Journal of Enology and Viticulture*, **25(2)**, 62-66.

Striegler RK, Lake CB, Morris JR, Threlfall RT, Main GL, Graves SG 2002. Minimal input production systems affect yield and juice quality of 'Sunbelt' grtapes in California's San Joaquin Valley, *HortScience*, **37(6)**, 867-870.

Szyjewicz E and Kliewer MW 1983. Influence and timing of ethephon application on yield and fruit composition of Chenin blanc grapevines, *American Journal of Enology and Viticulture*, **34(2)**, 53-56.

Szyjewicz E, Rossner N and Kliewer MW 1984. Ethephon ((2-chloroethyl) phosphonic acid, ethrel, CEPA) in Viticulture – A Review, *American Journal of Enology and Viticulture*, **35(3)**, 117-123.

Treeby M, Holzapfel BP and Friedrich CJ, 1996. Managing vine nitrogen supply to improve wine grape composition, In 'ASVO seminar – quality management in viticulture' (Eds R Hamilton, P Hayes, P Leske and R Paul).

Van Zyl JL 1984, Response of Colombard grapevines to irrigation as regards quality aspects and growth, *South African Journal of Enology and Viticulture*, **5**, 19-28.

Weaver RJ and Montgomery R 1974. Effect of ethephon on coloration and maturation of wine grapes, *American Journal of Enology and Viticulture*, **25**, 39-41.

Weaver RJ and Pool RM 1971a. Effect of ethephon and a morphactin on growth and fruiting of 'Thompson Seedless' and 'Carignane' grapes, *American Journal of Enology and Viticulture*, **22(4)**, 234-239.

Weaver RJ and Pool RM 1971b. Chemical thinning of grape clusters (*Vitis Vinifera* L.), *Vitis*, **10**, 201-209.

Weynard KM and Schultz HR 2005. Physiological responses of minimal pruning systems to gibberellic acid, Proc VIIth IS on Grapevine (ed. LE Williamms), *Acta Horticulturae*, **689**, 117-124.

Winkler AJ, Cook JA, Kliewer WM and Lider LA 1974, General Viticulture (2nd Ed.) University of California Press, Berkeley.

Zabadal TJ, VanEe GR, Dittmer, TW and Ledebuhr, R. 1997. Evaluation of chemical crop adjustment methods for mechanically pruned 'Concord' grapevines in South West Michigan. Proceedings for the 4th International Symposium on Cool Climate Viticulture and Enology, 18-23.

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APPENDIX 2 – Grower survey & results

Benchmarking the impact of oversupply in the vineyard

	Yes	No
Has your business been affected by over supply pressures?		

	Yes	No	How
Have you taken steps to mothball your vineyard?			
OR to reduce production?			
Do you require assistance with this?			

Property size (please specify Ha or Acres)	

Prior to oversupply pressures

Please answer the following as an indication of what you **would have** done **prior to** the oversupply pressures affecting **your** business.

Cover crops	Yes	No	Permanent cover crop
Would you normally plant a cover crop **prior** to oversupply pressures?			

Pest & Disease preventative spray program

Frequency of preventative spray application **prior** to oversupply pressures, assuming disease pressure is **NOT** high?

Once every 10 days	Once every 14 days	Once every 20 days	Other

Chemical types - which chemicals **would** you have used **prior** to oversupply pressures, assuming the disease pressure is **NOT** high?

Powdery Mildew			
Sulfur		Legend	
Prosper		DMI	
Flint		Ecocarb	
Cabrio		**None**	

Botrytis			
Filan		Sumisclex	
Teldor 500		Rovral	
Scala		Cheers 720	
Switch		Carbendazim	
Captan		**None**	

Downy Mildew			
Copper		Cabrio	
Polyram		Flint	
Dithane / Mancozeb		Ridomil	
Captan		Axiom	
Bravo / Cheers 720 etc		Acrobat	
Other		**None**	

Others

Weeds

What level of weed management strategy **would** you have used in the vineyard **prior** to oversupply pressures?

Strict - no weeds	Good - control of weeds but some weeds still present	Fair - control of weeds when numbers were high	None

What type of weed management strategy **would** you have used **prior** to oversupply pressures?

Chemical	Slashing	Cultivation	Combination - please specify

Chemical types - which chemicals **would** you have used **prior** to the oversupply pressures?

Illico		Roundup 360	
Hammer		Roundup PowerMAX	
Fusilade		Cameo / Surflan	
Basta		Sprayseed	
Roundup CT		Generic Glyphosate CT	
Stomp		Generic Glyphosate 360	
Simazine		**None**	

Other - please specify	

Nutrition

At what timings **would** you have applied fertiliser **prior** to oversupply pressures, assuming an average growth / quality year?

Whites	Budburst	Flowering	Veraison	Post harvest	Other

Reds	Budburst	Flowering	Veraison	Post harvest	Other

How often **would** you have applied foliar fertiliser **prior** to oversupply pressures assuming an average growth / quality year?

fix deficiencies only	less than 5 sprays /yr	between 5-10 sprays / yr	greater than 10 sprays / yr

Types of fertilisers used **prior** to oversupply pressures?

Liquids	Soluble solids	Granular broadcast fertiliser

	Yes	No
Prior to oversupply pressures **would** you have monitored soil nutrients and characteristics through a soil test?		
Prior to oversupply pressures **would** you have monitored plant nutrients through a petiole test?		

Irrigation

	Yes	No
Prior to oversupply pressures **would** you have considered making up-grades on your irrigation system?		
Prior to oversupply pressures **would** you have considered converting to a fertigation system for nutrient delivery?		
Prior to oversupply pressures **did** you consider installing irrigation scheduling equipment?		
Prior to oversupply pressures **did** you use irrigation scheduling equipment?		

If so what type of irrigation scheduling equipment **did** you have?

Gypsum blocks / G-bugs	Tensiometers	Neutron probes	EnviroScan	C-probes

Prior to oversupply pressures how often **would** you conduct maintenance on your irrigation system during the season?	

Pruning

Prior to oversupply pressures **would** you have normally:

Machine prune	Hand prune	Machine prune & hand clean up	Minimal prune	Other

Consultants

Prior to oversupply pressures **would** you have employed a consultant for advice and planning in any of the following areas? Please specify which areas

Nutrition	Soil management & surveying	Irrigation	Bud dissection	Pruning	Pest & disease	Other

New Technology

	Yes	No
Prior to oversupply pressures **would** you have been interested in learning about new vineyard management technologies?		
Prior to oversupply pressures **would** you have considered adopting new vineyard management technologies?		

Mothballing

	Yes	No
Prior to oversupply pressures **would** you have considered mothballing part of a patch?		
Prior to oversupply pressures **would** you have considered mothballing a whole patch?		
Prior to oversupply pressures **would** you have considered reducing input costs on a patch that could not be sold?		
Prior to oversupply pressures **would** you have considered reducing the crop load on a patch that could not be sold?		

06/07 Season

Please answer the following as a indication of what you plan to do in the 06/07 season.

Cover crops	Yes	No	Permanent cover crop
Did you plant a cover crop?			

Pest & Disease preventative spray program

This season how often are you planning to apply preventative pest & disease sprays?

Once every 10 days	Once every 14 days	Once every 20 days	Other

Which chemicals do you anticipate using this season?

Powdery Mildew			
Sulfur		Legend	
Prosper		DMI	
Flint		Ecocarb	
Cabrio		**None**	

Botrytis			
Filan		Sumisclex	
Teldor 500		Rovral	
Scala		Cheers 720	
Switch		Carbendazim	
Captan		**None**	

Downy Mildew			
Copper		Cabrio	
Polyram		Flint	
Dithane / Mancozeb		Ridomil	
Captan		Axiom	
Bravo / Cheers 720 etc		Acrobat	
Other		**None**	

Others

Weeds

What level of weed management strategy do you anticipate using in the vineyard this season?

Strict - no weeds	Good - control of weeds but some weeds still present	Fair - control of weeds when numbers were high	None

What type of weed management strategy do you anticipate using in the vineyard this season?

Chemical	Slashing	Cultivation	Combination - please specify

Chemical types - which chemicals do you anticipate using this season?

Illico		Roundup 360		Roundup CT	
Hammer		Roundup PowerMAX		Generic Glyphosate CT	
Fusilade		Cameo / Surflan		Generic Glyphosate 360	
Basta		Sprayseed		Other - please specify	
Simazine		Stomp		**None**	

Nutrition

At what timings do you anticipate applying fertiliser this season?

Whites	Budburst	Flowering	Veraison	Post harvest	Other

Reds	Budburst	Flowering	Veraison	Post harvest	Other

This season how often do you anticipate applying foliar sprays?

fix deficiencies only	less than 5 sprays	between 5-10 sprays	greater than 10 sprays

Types of fertilisers to be used this season:

Liquids	Soluble solids	Granular broadcast fertiliser

	Yes	No
Will you monitor soil nutrients and characteristics through a soil test this season?		
Will you monitor plant nutrients through a petiole test this season?		

Irrigation	Yes	No
This season will you consider making up-grades on your irrigation system?		
This season will you consider converting to a fertigation system for nutrient delivery?		
This season will you consider installing irrigation scheduling equipment?		
This season will you use irrigation scheduling equipment?		
If so what type of irrigation scheduling equipment will you use?		

Gypsum blocks / G-bugs	Tensiometers	Neutron probes	EnviroScan	C-probes

This season how often will you conduct maintenance on your irrigation system ?	

	Yes	No
Have you decreased the amount of water applied to the vineyard as a result of oversupply pressures?		

Pruning

What type of pruning management strategy did you use this season:

Machine prune	Hand prune	Machine prune & hand clean up	Minimal pruning	Other

Consultants

Will you employ a consultant for advice and planning in any of the following areas this season?

Nutrition	Soil management & surveying	Irrigation	Bud dissection	Pruning	Pest & disease	Other

New technology	Yes	No
Will you be interested in learning about new vineyard management technologies this season?		
Will you consider adopting new vineyard management technologies this season?		

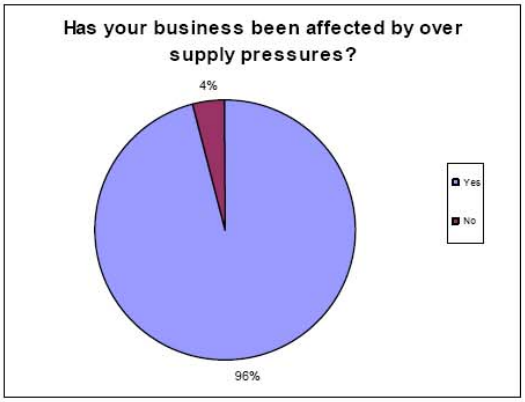
Mothballing	Yes	No
Will you consider mothballing part of a patch this season?		
Will you consider mothballing a whole patch this season?		
Will you consider reducing input costs on a patch that can not be sold this season?		
Will you consider reducing the crop load on a patch that can not be sold this season?		

Community

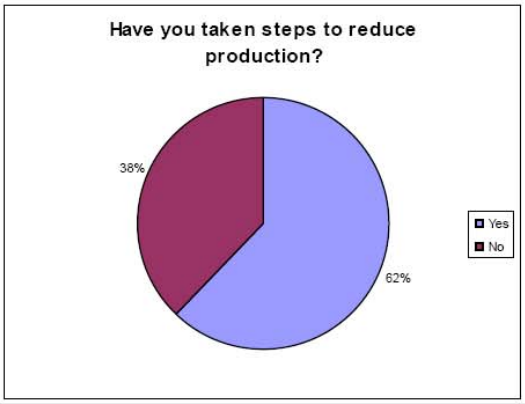
As a result of the oversupply pressures, has your spending decreased in the:	Yes	No
Agricultural / horticultural community e.g. chemical merchandise stores, machinery, land etc?		
Mildura and Swan Hill regional communities i.e. money spent in the towns?		

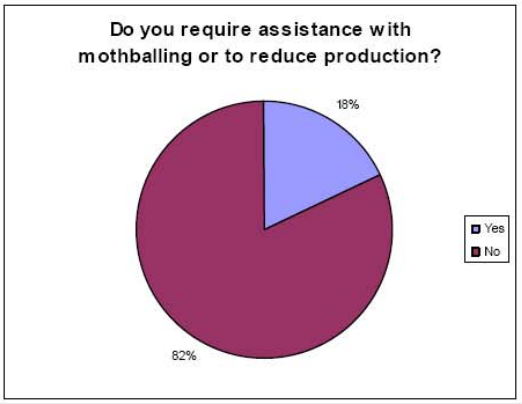
Thank you for your assistance.

Grower Survey Results

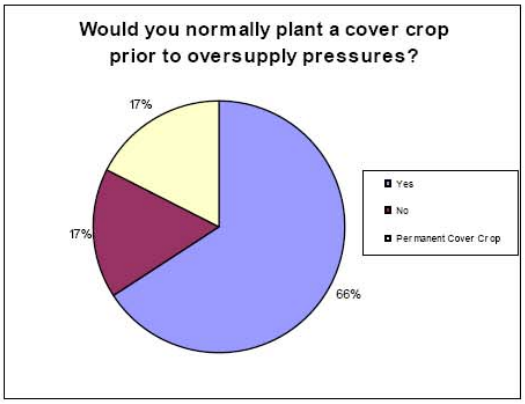


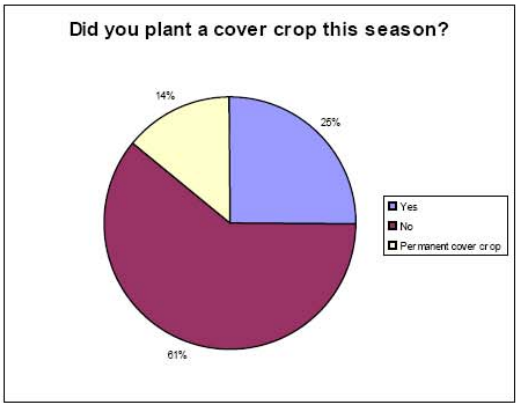


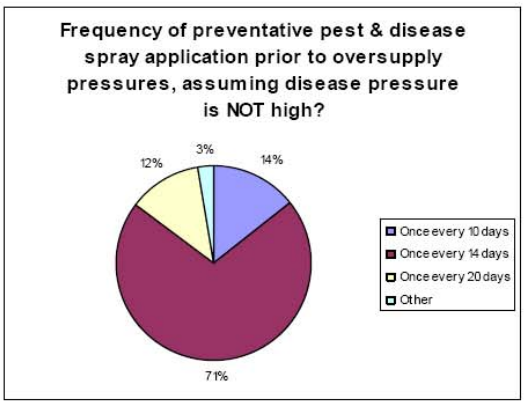


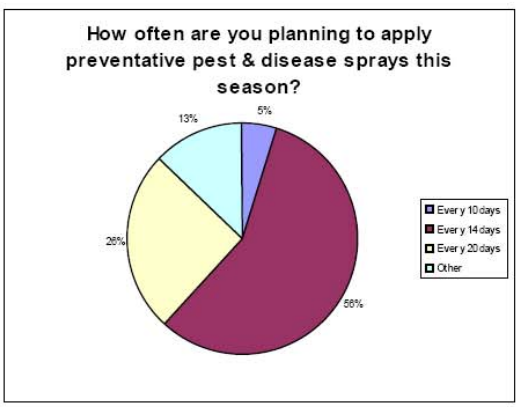


Prior to over supply **Over supply**

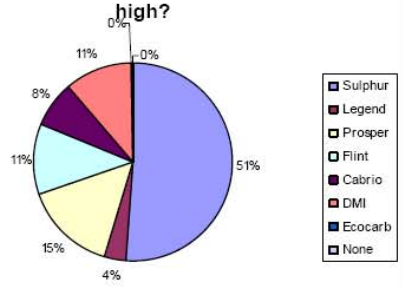




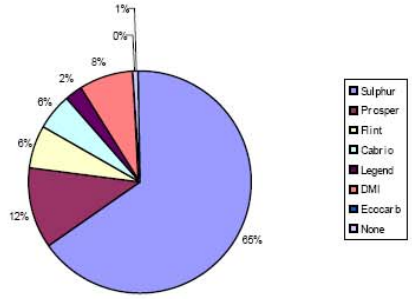




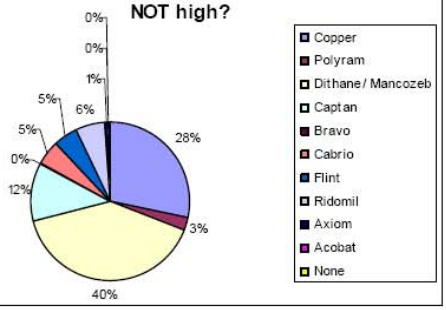
Which chemicals would you have used prior to oversupply for powdery mildew, assuming the disease pressure is NOT high?



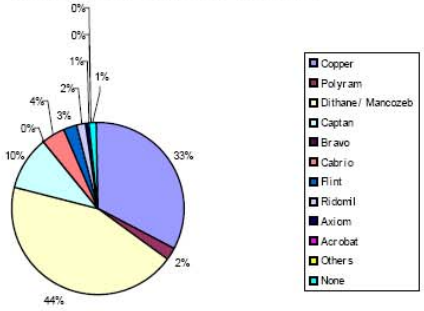
Which chemicals do you anticipate using this season for powdery mildew?



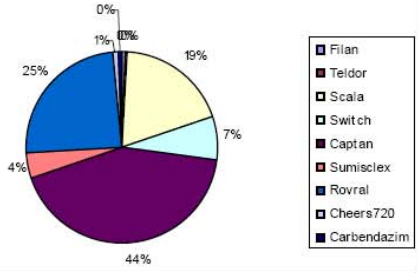
Which chemicals would you have used prior to oversupply pressure for downy mildew, assuming disease pressure is NOT high?



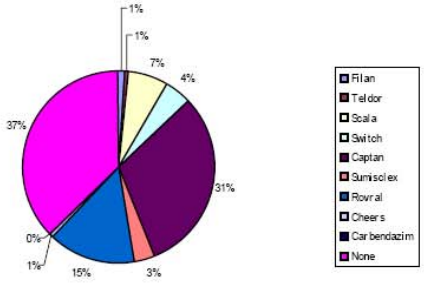
Which chemicals do you anticipate using this season for downy mildew?



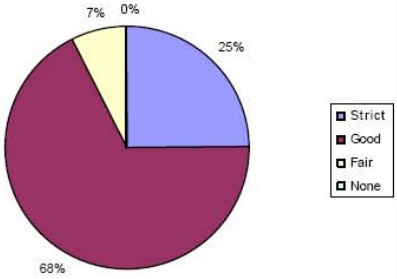
Which chemicals would you have used prior to oversupply pressures for botrytis, assuming the disease pressure is NOT high?



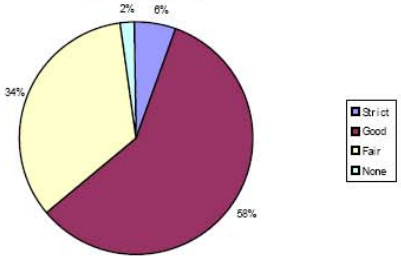
Which chemicals do you anticipate using this season for botrytis?



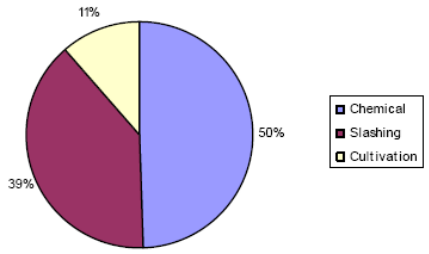
What level of weed management strategy would you have used in the vineyard prior to oversupply?



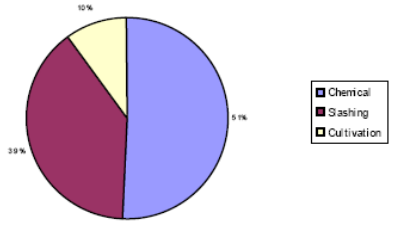
What level of weed management strategy do you anticipate using in the vineyard this season?



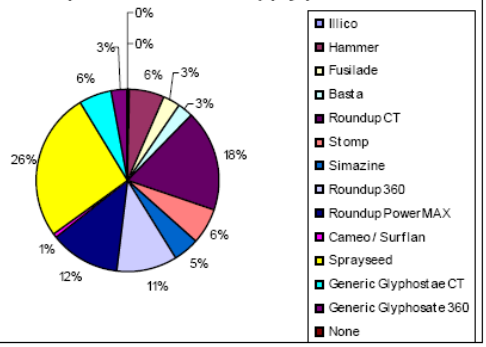
What type of weed management strategy would you have used prior to oversupply pressures?



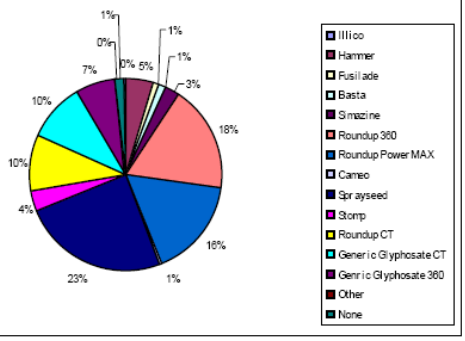
What type of weed management strategy do you anticipate using in the vineyard this season?



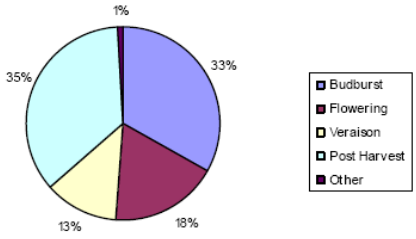
Which types of chemicals would you have used prior to the oversupply pressures?



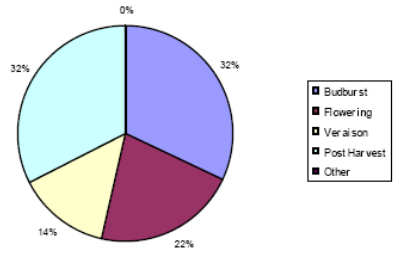
Which chemicals do you anticipaye using this season to control weeds?



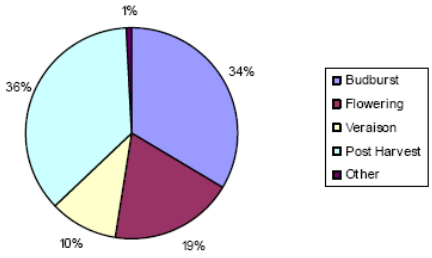
What timings would you have applied fertiliser prior to oversupply pressures for white grape varieties, assuming an average growth/quality year?



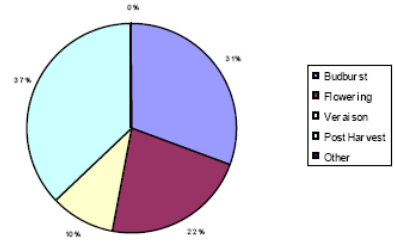
At what timings do you anticipate applying fertiliser for white grape varieties this season?



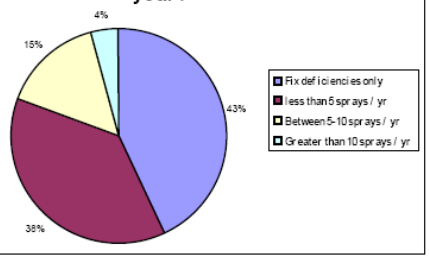
What timings would you have applied fertiliser prior to oversupply pressures for red grape varieties, assuming an average growth/quality year?



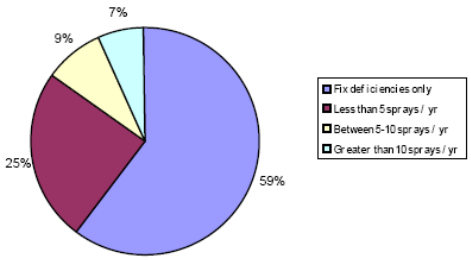
At what timings do you anticipate applying fertiliser to red grape varieties this season?



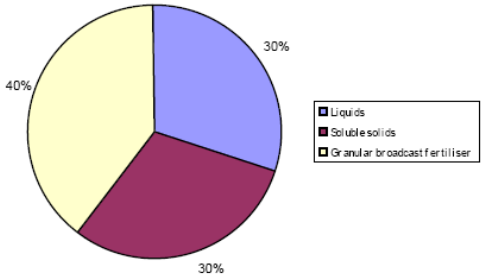
How often would you have applied foliar fertiliser prior to oversupply pressures, assuming an average growth/quality year?



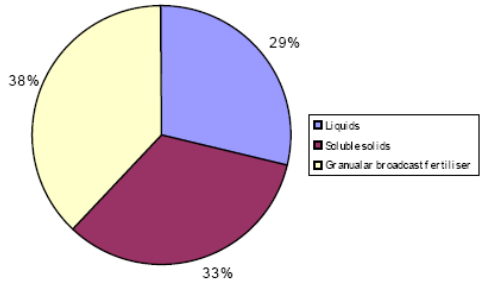
How often do you anticipate applying foliar fertiliser this season, assuming an average growth / quality year?



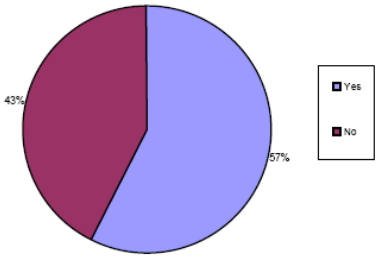
What types of fertiliser would you have used prior to oversupply pressures?



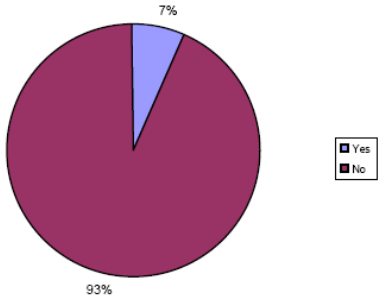
What type of fertiliser do you anticipate using this season?



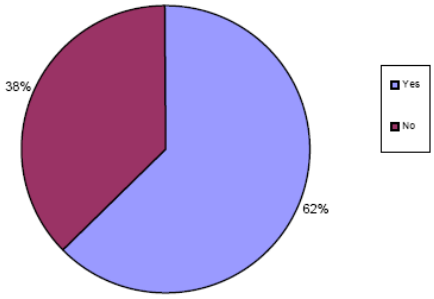
Prior to oversupply pressures would you have monitored soil nutrients and characteristics through a soil test?



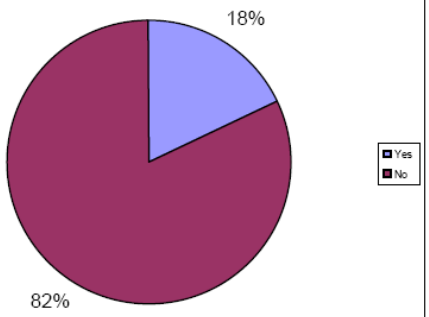
Will you monitor soil nutrients and characteristics through a soil test this season?



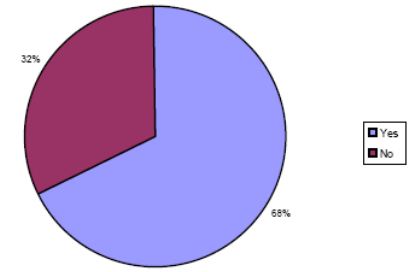
Prior to oversupply pressures would you have monitored plant nutrients through a petiole test?



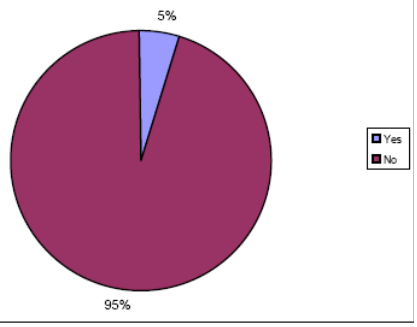
Will you monitor plant nutrients through a petiole test this season?



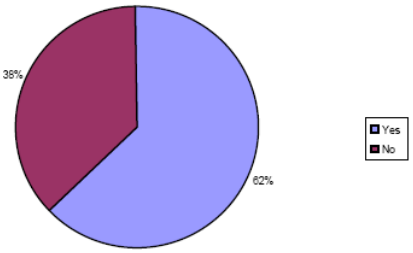
Prior to oversupply pressures would you have considered making up-grades on your irrigation system?



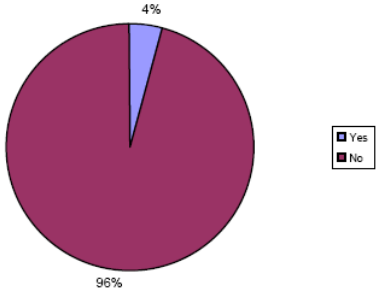
This season will you consider making up-grades on your irrigation system?



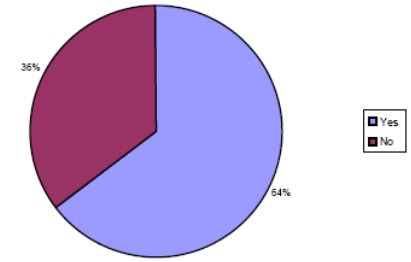
Prior to oversupply pressures would you have considered converting to a fertigation system for nutrient delivery?



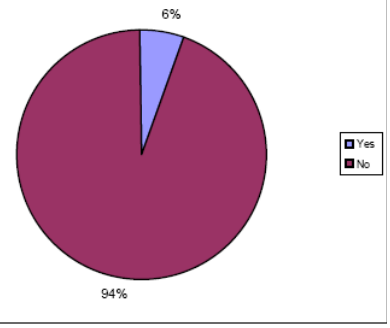
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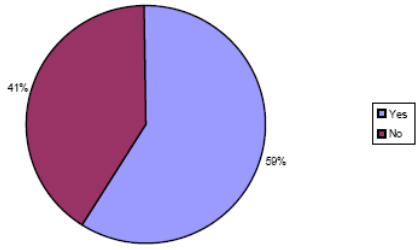
Prior to oversupply pressures did you consider installing irrigation scheduling equipment?



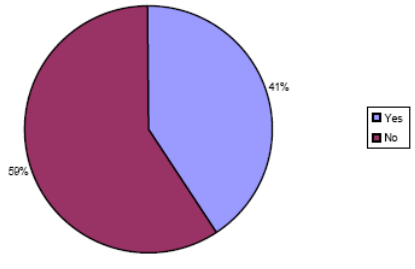
This season will you consider installing irrigation scheduling equipment?



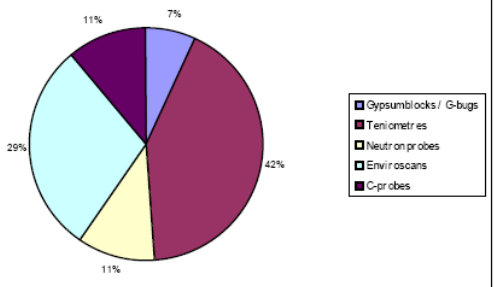
Prior to oversupply pressures did you use irrigation scheduling equipment?



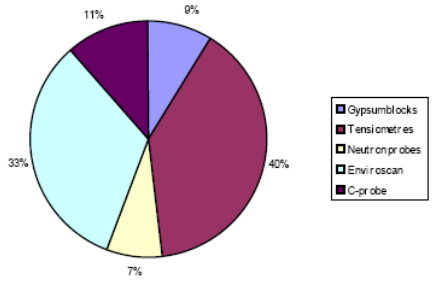
This season will you use irrigation scheduling equipment?



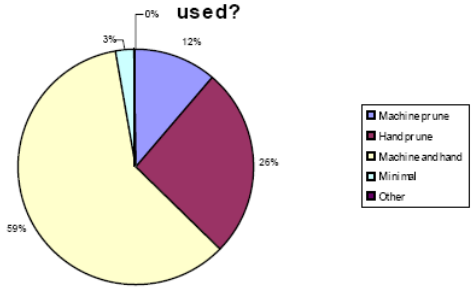
If you used irrigation scheduling equipment prior to oversupply pressure, what type did you use?



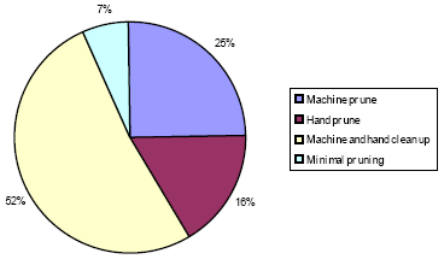
If so what type of irrigation scheduling equipment will you use?



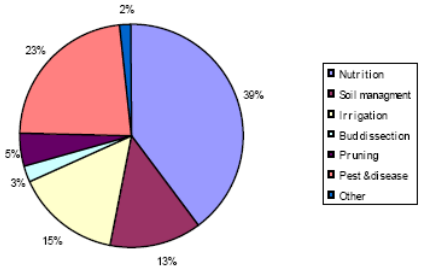
Prior to oversupply pressures what pruning techniques would you have used?



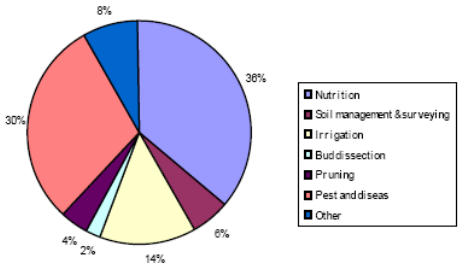
What type of pruning management strategy did you use this season?



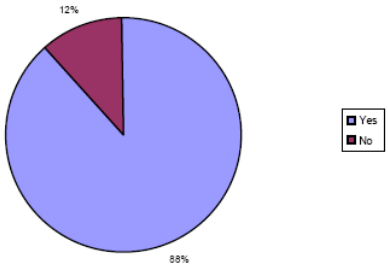
Q24 Prior to oversupply pressures would you have employed a consultant for advice and planning in any of the following areas?



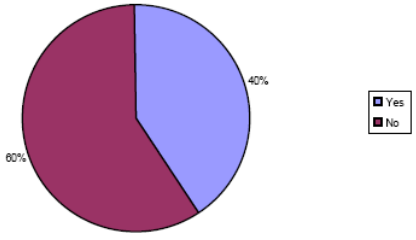
Will you employ a consultant for advice and planning in any of the following areas this season?



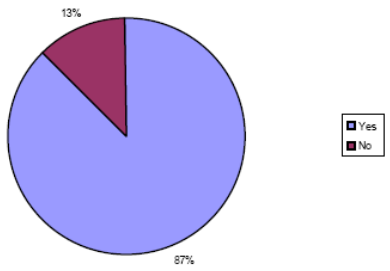
Prior to oversupply pressures would you have been interested in learning about new vineyard management technologies?



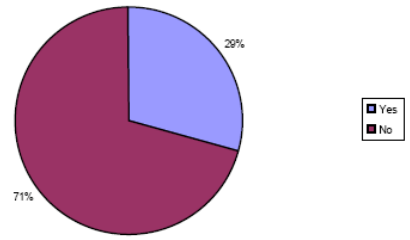
Will you be interested in learning about new vineyard management technologies this season?



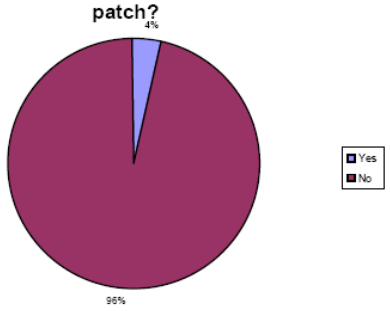
Prior to oversupply pressures would you have considered adopting new vineyard management technologies?



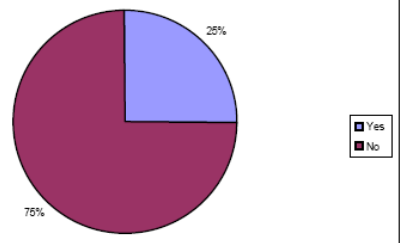
Will you consider adopting new vineyard management technologies this season?



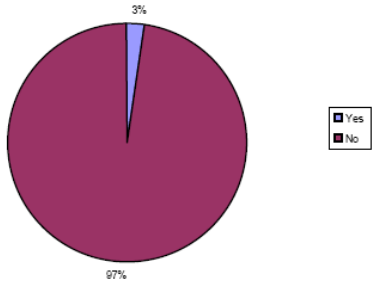
Prior to oversupply pressures would you have considered mothballing part of a patch?



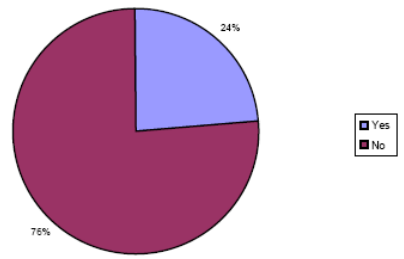
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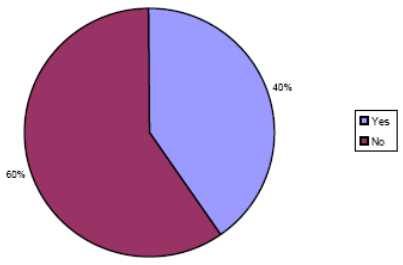
Prior to oversupply pressures would you have considered mothballing a whole patch?



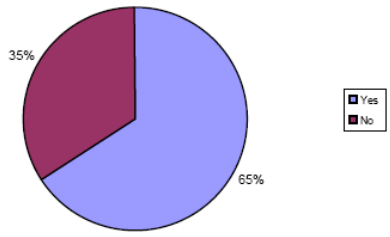
Will you consider mothballing a whole patch this season?

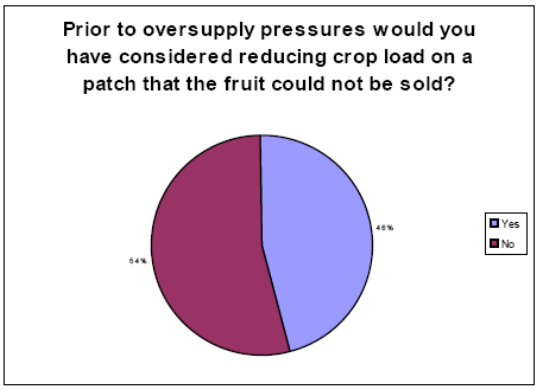


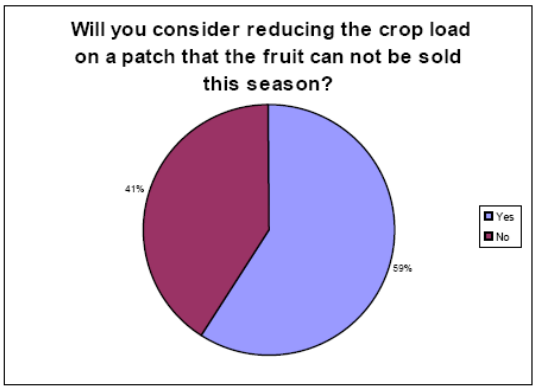
Prior to oversupply pressures would you have considered reducing input costs on a patch that could not be sold?

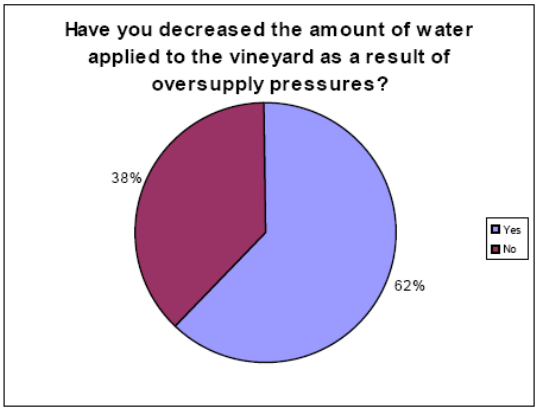


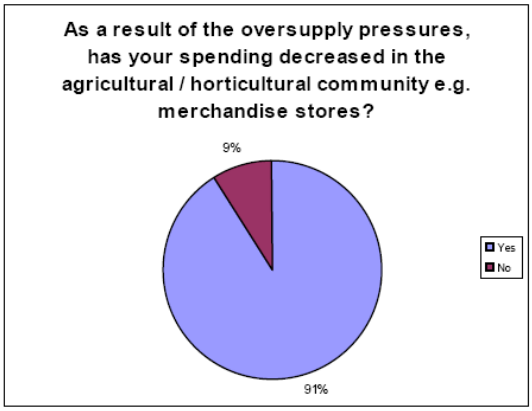
Will you consider reducing input costs on a patch that the fruit can not be sold this season?

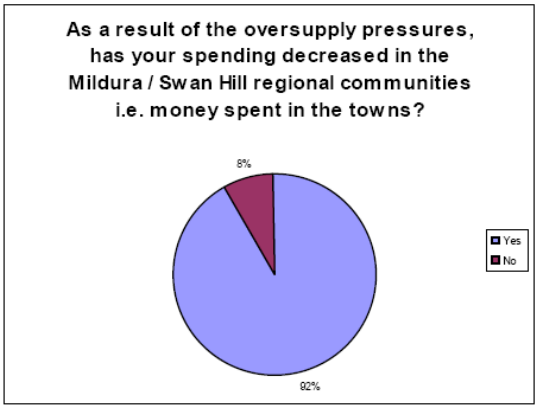



Prior to oversupply pressures would you have considered reducing crop load on a patch that the fruit could not be sold?
46%
54%
Yes
No


Will you consider reducing the crop load on a patch that the fruit can not be sold this season?
41%
59%
Yes
No


Have you decreased the amount of water applied to the vineyard as a result of oversupply pressures?
38%
62%
Yes
No


As a result of the oversupply pressures, has your spending decreased in the agricultural / horticultural community e.g. merchandise stores?
9%
91%
Yes
No


As a result of the oversupply pressures, has your spending decreased in the Mildura / Swan Hill regional communities i.e. money spent in the towns?
8%
92%
Yes
No

APPENDIX 3 – Industry Forum Report

Mothballing Strategies Forum
16th August 2006 – DPI Irymple

Compiled by Liz McGuire – Murray Valley Winegrowers' Inc.

Executive Summary

The GWRDC-RITA funded Mothballing project aims to investigate various steps of mothballing, its implementation and the consequences. "Mothballing" is a term that has been associated with the need to place vineyards into a non-productive state to allow the industry to return to balanced supply and demand model.

Mothballing has yet to be investigated, and as such, the short and long-term effects and the time required in returning the vineyard to a productive state is unknown. One component of this project is to hold a Mothballing Strategic Forum.

The Mothballing Strategies Forum invited industry representatives, viticultural consultants and industry scientists to participate in an exercise designed to determine and explain potential techniques to mothball a vineyard. The participants nominated a list of potential mothballing techniques, as listed below;

1. Chemical removal of fruit,
2. Physical removal of fruit,
3. Minimal input,
4. Severe winter pruning,
5. Cutting the vine below the cordon,
6. Removing the top cordon,
7. Irrigation stress at flowering and,
8. Zero Input.

Participants discussed the pros and cons of each technique, they considered the short and long term effects these techniques could have in the vineyard and they contemplated the time it would take to return the vineyard to a productive state.

After considering each technique, the group indicated that options 1-4 were the "best, most practical" potential techniques for mothballing the vineyard, ie, resulting in minimal effect on the vineyards return to productivity after one seasons of implementation. Option 3 was seen as a technique that would be used in co-operation with most potential mothballing techniques. Options 5-8 were not seen as practical options for mothballing the vineyard, and option 8 seen only as an approach to exit the industry, however, the group would not advocate this technique. Overall, it was clearly conveyed that these techniques should only be considered in the short-term only (one season). There was some uncertainty with specific techniques, such as the use of Ethrel to remove fruit.

Major concerns expressed by the group, however, indicated that mothballing the vineyard would not provide the silver bullet for growers, and that mothballing the vineyard could in fact cost as much to maintain a producing vineyard. (These claims are not addressed in this report but will be addressed as part of the bigger project.) Forum participants emphasised that growers would need to assess the age of the vineyard, the health of the vines, vineyard variability, vine nutrition, pest & disease pressures before implementing any potential mothballing technique. Implementing potential mothballing techniques would be very specific to individual vineyard situations and these conditions would determine the rate of success and the time required to return the vineyard to productivity.

Detailed in this report is a compilation of ideas and thoughts collected from participants regarding potential techniques for mothballing the vineyard.

Project Committee

- Liz McGuire – Murray Valley Winegrowers' Inc,
- Nicole Dimos – DPI VIC,
- Jeff Milne – DPI VIC,
- Mark Krstic – DPI VIC

- Greg Moulds – NSW DPI,
- Jeremy Giddings – NSW DPI,
- Peter Clingleffer – CSIRO.

Forum Facilitator

- Stephen Kelly – Evaluation and Facilitation Specialists

Forum Participants

Industry / Viticultural consultants	**Government**
Marcus Everett – Foster Wine Estates	Mark Krstic – VIC DPI
Jason Cappello – Riverina Industry Development Officer	Bob Emmett – VIC DPI
Tim Smythe – Riverland Industry Development Officer	Keiran Murphy –DPI VIC
Jim Hardie – CEO – CRCV	Michael Treeby – CSIRO
Guy Darling – King Valley Winegrape Growers Association	Peter Magarey – SARDI – S.A
Kym Ludvigsen – Viticultural consultant – Grampians	Mike McCarthy – SARDI – S.A
Jan O'Connor – O'Connor Harvesting	
Denis Mills – Murray Valley Representative	

Aims of the forum

- List potential techniques for mothballing the vineyard,
- Detail strengths and weaknesses of each technique, so growers could make informed decisions if deciding to implement techniques,
- Identify potential short and long-term implications for these techniques on future vine health and fruit quality,
- Assess how quickly the vineyard could be returned to production after using these techniques of mothballing,
- Rank techniques in terms of practicality that growers could implement in the vineyard.

Potential Mothballing Technique Reports

Please note the information contained below was obtained from the participants of the forum and has no specified scientific basis at this point in time. As such the information should be viewed with caution.

1. Chemical Crop Removal

Chemicals including Ethrel, Calcium Nitrate, Urea etc. have been suggested as possible options for use at flowering to desiccate flowers and remove the majority of the crop.

The **benefits** of this method regardless of the agent include:

- Decreased water use and disease risk,
- There would be a decreased demand on vine carbohydrates,
- May decrease fruitfulness and reduce cropping load in the next season if the industry situation hasn't improved,
- Replicating the effect of frost,
- Could use chemicals for disbudding purposes,
- Cost effective.

The **disadvantages** include:

- Decreased opportunities to market fruit for sale because it has been removed,
- Need to adjust disease program to account for changes in growth age,
- Still has a cost,

- May be some drift effect though this is thought to be minimal,
- Ethrel may have longer term effects on production,
- May have an increase in shoot length, which will require extra management, though it will depend on the time of treatment,
- Ethrel currently has no registration for this purpose and has no MRL,
- Increased vine vigour,
- Unintended consequences,
- There will likely be varietal differences in regards to rates and timings.

Participants were asked to consider the **short and long-term effects** chemical removal would have on the vineyard taking into consideration vine health, fruitfulness, vigour pest and disease, etc.

The **short-term** effects that were communicated by the participants included the following:

- There was some concern that GA was not a viable option due to seed component of winegrapes,
- There seemed to be no effect of the chemicals listed on vine health,
- There was uncertainty about the effect of the chemicals listed on bud fruitfulness though some participants indicated that there should be no effect,
- Vigour was agreed would increase as a result of fruit removal,
- This technique would require a minimal input program and good monitoring of vine health and nutrition to work,
- There were some concerns about Ethrels' S6 status and the OH&S risks involved with the use of this chemical.

The **long-term** effects included:

- Ethrel and GA should have no effect of vine health,
- Some participants indicated that the application of calcium nitrate or urea could possibly increase vine health due to the application of nitrogen,
- The effect Ethrel on bud fruitfulness was unknown though some believed that there may be no effect. The use of Ethrel may increase vigour though largely the effect on vigour was unknown.
- Participants had mixed thoughts on the use of calcium nitrate. They believed it could increase bud fruitfulness, have no effect or the effect was unknown,
- The use of urea was thought to increase bud fruitfulness or the effect was unknown,
- The use of GA was thought to have no effect on bud fruitfulness or vigour,
- The use of calcium nitrate or urea would increase vigour,

Other possible chemicals suggested included:

- Sulfur, Zinc, Sprayseed, Carbomate, NAA.

2. Physical Removal of Fruit

Physical removal was discussed in regards to harvester use at pea size berries and the use of box hedging in summer when the fruit has set and trying to remove as much fruit and canopy at this stage.

The **benefits** of this method included:

- Decreased vine inputs,
- Quick and environmentally friendly,
- Don't have to use chemicals,
- Decreased disease risk if summer pruning is applied,
- No MRL issues,
- Still have the opportunity to sell the fruit due to the timing of operations,

- Cutter bars are cheap and many growers have the ability to use them without involving a contractor,
- Minimise canopy.

The **disadvantages** of this method included:

- Potential increase in vigour especially with harvest removal of fruit,
- Cost involved,
- Never 100% of fruit removed,
- Requires timely availability of service and equipment especially when using the harvester,
- Damage to vine,
- Damage to canopy and canes from the harvester could increase pests and disease,

Participants were asked to consider the **short and long-term effects** of this technique on the vineyard, taking into consideration; vine health, fruitfulness, vigour pest and disease, etc.

A. Harvest removal of fruit (berries at either pea-sized or veraison)

The **short-term** effects of this method included:

- Increased vigour,
- Increased fruitfulness,
- Vine health unchanged,
- No effect on pest and disease,
- Nil effects on vine,

The **long-term** effects of this method included:

- Increased vigour, irrigation management important,
- Vine strength possible reduced over a number of season, decreased carbohydrate stores,
- Possible decreases in fruitfulness with high vigour shaded vines,
- Nil effects.

B. Fruit and canopy removal at fruit set

The **short-term** effects of this method included:

- Major regrowth of shoots,
- Increased number of shoots per vine,
- Secondary buds shooting,
- Pest and disease pressures with new shoot growth and residual fruit,
- Decreased water use,
- Potential sunburn of new tissue,
- Decrease in bunch and berry weight.

The **long-term** effects of this method included:

- Carbohydrate decline,
- Delayed vine recovery,
- Declining fruitfulness – will depend on vine status before the treatment,
- Changed architecture,
- More buds per vine,
- More costs in regards to spraying and pruning,
- Congested spurs.

3. Minimal inputs

This technique involved the use of vineyard management techniques that used the minimum amount of inputs to maintain the vineyard's health and production potential.

The **benefits** of this method included:

- Cost saving,
- Opportunity to obtain off farm income,
- Temporary water trade,
- Reduced vine vigour and crop load,
- Promotes best management practices,
- Reduced vigour could assist with pest and disease management.

The **disadvantages** of this method included:

- Strategy and implementation costs,
- Risk of prolonged recovery period,
- Risk of pest and disease proliferation if strategy is inadequate,
- Opportunity cost (ie the need to maintain the vineyard instead of investigating alternative enterprises),
- May not affect crop load,
- Relatively high cost compared to other more destructive methods,
- Weed control.

Participants were asked to consider the **short and long-term effects** of this technique on the vineyard on fruitfulness, carbohydrates, vine health, pest and disease, nutrition, water, soil health etc.

The **short-term** effects for this method included:

- No effect on fruitfulness,
- No effect on carbohydrates,
- Slight effect on vine health and nutrition,
- Moderate effect on pest, disease and water stress,
- No effect on soil health,
- Will be dependent on soil type, variety, rootstock and region and will require good monitoring and management.

The **long-term** effects of this method included:

- Slight effect on fruitfulness,
- Moderate effect on carbohydrates, vine health, pest and disease, nutrition and water stress,
- No effect on soil health,
- Depletion of soil fertility at depth,
- Improvements due to organic matter addition?

4. Severe Winter Pruning

This involved the removal of as much fruitful wood as possible. This could include hand pruning or the box hedging very tightly.

The **benefits** of this technique included:

- Maintain vine structure for return to productivity,
- Reduced crop load and canopy will make it easier to manage vine health under a reduced input regime,
- Cost effective,
- Only single season effectiveness,

The **disadvantages** of this method included:

- Potential vigour control problems,
- Tight bunches,
- Eutypa risk increased,
- Crop load will increase,
- Disease control?
- Has to be combined with minimal input to work,
- Increased management of wood removal,
- Excessive shoot growth,
- May need specialist equipment which could involve a contractor,
- Cost,
- Trellis / cordon configuration may not be appropriate.

Participants were asked to consider the **short and long-term effects** of this technique on the vineyard, taking into consideration; bud fruitfulness, vigour, carbohydrates vine health, fruitfulness, vigour pest and disease, etc.

The **short-term** effects included:

- Decreased yield potential,
- Vigour issues, could induce a vigour cycle,
- Improve vine structure,
- Moderate effect on fruitfulness and vigour,
- No effect on vine carbohydrates,
- Increase in pest and disease?
- Minimal effect on vine health,
- Training and desuckering management costs.

The **long-term** effects included:

- Trunk disease issues,
- Improved vine structure,
- Removal of MOG potential and diseased wood,
- Decreased fruitfulness,
- Minimal effects on vigour, carbohydrates, pest and disease,
- Slight effect on vine health,
- Reduce vine variability, getting rid of non-productive cordons,
- Encourages latent buds.

5. Cutting cordons

This method involves the cutting of cordons at two different levels, either under the bottom cordon leaving only the trunk or above the first cordon and just removing the top wire. The practicality of this method and the cost involved in re-training questions whether this would be a viable option for growers looking to mothball the vineyard.

The **benefits** of this method included:

- Crop removal or crop reduction,
- Save inputs in regards to water and sprays,
- Can restructure vines when retraining,
- Opportunities for new trellis design,
- Should get a good number of shoots for retraining.

The **disadvantages** of this method included:

- Cost of removing the wood,
- Cost of retraining,
- Phomopsis danger,

- Eutypa – the cost of preventative treatment,
- Increased diseased pressure as a result of dense sprawled canopy,
- Not mothballing,
- Crop load balance harder to manage,
- Effects on saleable fruit quality,
- Huge number of shoots that need to be managed,
- Suckering issue.

Participants were asked to consider the **short and long-term effects** of this technique on the vineyard, taking into consideration; vine health, fruitfulness, vigour pest and disease, etc.

A. Cutting the top cordon off

The **short-term** effects included:

- Only the majority of the crop not all the crop,
- Increase vegetative growth,
- Increased pest and disease pressures?
- Decreased fruitfulness.

The **long-term** effects included:

- only have one cordon left,
- ease of management – pruning / harvest,
- alternative vigour / canopy management strategies required,
- fruitfulness will increase over time,
- relatively stable fruitfulness,
- increased vigour and disease (eutypa and phomopsis risk).

B. Cutting vines below the cordon

The **short-term** effects for this method included:

- Total fruit removal,
- Increased vegetative growth,
- Variable responses,
- Costly,
- Decreased fruitfulness,
- Increased disease risk,
- Potential for some vines to die,
- Vineyard variability will become more obvious.

The **long-term** effects of this method included:

- Likely to loose the crop for 2 yrs,
- Big retraining cost,
- Vine and vineyard variability,
- Decreased fruitfulness,
- Increased vigour and disease risk,
- Potential for some vines to die.

6. Irrigation stress at flowering

This method involved severe irrigation stress at flowering to induce bud abortion. This method requires a lot of attention to detail and the rate of success would depend on rain at flowering and whether the vine could source moisture from the soil even under irrigation stress. This method may cause a smaller set but would never return a 100% success rate.

The **benefits** of this technique included:

- Crop could drop off,
- Decreased irrigation will produce smaller vines and reduced vigour,
- Lower disease pressure,
- Water savings, temporary transfer or use of water for a more productive use,
- Irrigation system may require less maintenance?
- Environmental benefits?

The **disadvantages** of this technique included:

- Vines could die if the irrigation stress is too severe,
- Lower carbohydrate reserves,
- Rain could ruin the process, lack of control,
- Rootstock influence,
- Block variation will influence success,
- Need to have precise timings in place,
- Average grower may struggle to get success with this method,
- Impact on bud fruitfulness,
- Decreased root biomass,
- Not effective at flowering only,
- Salinity issues could influence the effect on the vines,
- Increased weedicide costs,
- Not possible in non-irrigated regions with high rainfall,
- Physical system restrictions.

Participants were asked to consider the **short and long-term effects** of this technique on the vineyard, taking into consideration; vine health, fruitfulness, vigour, etc.

The **short-term** effects included:

- Less vigour,
- Smaller bunches,
- Decreased yield,
- Decreased bud fruitfulness,
- Stable vine health,
- % of crop would remain.

The **long-term** effects included:

- Potential increase in bud fruitfulness due to a more open canopy and increased exposure to sunlight,
- Possibly large crop in following year if increases in fruitfulness,
- Possible decrease in fruitfulness if levels of stress is too high or the timing is off,
- Stable vine health,
- Stable vigour ,
- Chances of permanently debilitating vines.

7. Zero Input

This method was indicative of walking away and not maintaining any part of the vineyard. Fixed costs such as rates would still need to be considered and the forum participants indicated that if this was the path chosen, an exit from industry strategy should be examined.

The **benefits** of this technique included:

- Low cost,
- Retain vine structure,
- Could add livestock to the vineyard as an alternative enterprise,
- Potential to divert water use,
- Decreased labour inputs,

- Opportunity to obtain off farm income.

The **disadvantages** of this technique include:

- Increased risk of disease and carry over of disease,
- Legal implications of walking away,
- Decreased carbohydrate reserves,
- Degradation of vine structure,
- The variability in the vineyard will become more noticeable,
- Introducing new enterprises costs money and requires some skills,
- High cost to return to production or to redevelop vines.

Participants were asked to consider pest and disease, pruning to get back to quality, nutrition, fruitfulness, etc when considering the potential **short and long-term** effects on the vineyard.

The potential **short-term** effects included:

- Pest, disease and weed build-up,
- Minimal nutrition effect,
- No effect on pruning,
- A perceived increase in bud fruitfulness,
- No dramatic effects in year 1.

The **long-term** effects included:

- Pest, disease and weed build-up,
- High input levels to return vineyard to production,
- Carbohydrate depletion,
- Smaller vines,
- Neighbour complaints,
- Legal implications,
- Buyers perception,
- Decreased fruitfulness,
- Vines could die.

Ranking

Participants were asked to choose the method they felt would be most practical for growers to use and had the best rate of success and return to productivity. Participants made their decision and reached four different techniques:

Technique	Chemical removal of fruit	Physical removal of fruit	Minimal Inputs	Severe winter pruning
No. of votes	4	4	5	3
Reasoning	Cheap and effective	No disease problems	Totally integrated	Maintain good vine structure
	Still maintains vine health	It had been done before with success	Could get the vineyard back into production quickly	Can get back into production quickly
	The technique would need to be combined with a minimal input program to effectively control vigour after the fruit sink was removed	Vine health and vine carbohydrates are maintained	The last chance for management and that you were still controlling management	May get more fruit in the following year.
	Can get back into production quickly.	Allows flexibility to sell fruit.	Effective.	Cost effective

				Left very little crop.

Participants were also asked to choose a method they thought was least practical, with the lowest rate of success and return to productivity. Participants made their decision and reached the alternative three techniques:

Technique	Cutting cordons	Water stress at flowering	Zero inputs
No. of votes	7	2	6
Reasoning	Of the cost involved	A low probability of success	Creating more serious problems
	The amount of labour needed to get the vineyard back into production	If not carried out in a precise manner it could cause stress and death of vines	Choosing this option indicated exiting the industry
	Vineyard variability could cause stress which could cause a mixed return to production or vines to die	Vineyard variability could limit the success and the return to productivity.	Serious costs involved in returning the vineyard to production
	The risk of trunk diseases.		Legal implications.

APPENDIX 4 – Trial Design & Results

Mothballing – Potential Techniques and their Impacts

Compiled By: Gregory Moulds - District Viticulturalist, NSW DPI, Dareton

Introduction

In the 2004/05 and the 2005/06 seasons, the Australian winegrape industry struggled with oversupply, many growers' were forced to harvest good crops onto the ground. Mothballing became a hot topic in the industry, with many growers hopeful for solutions that would cut costs while protecting long-term vineyard viability.

Mothballing has been defined for this trial as *"To maintain a non-producing vineyard with minimum but critical inputs to allow a rapid return to cropping for productive use / sale in the future when the industry situation has improved."*

The trial was conducted at the NSW DPI Dareton Research Station. The treatments used in this trial were developed mostly from a Mothballing Strategies Forum that was held in Mildura on the 16th of August 2006 as part of the GWRDC Mothballing RITA project.

Treatments used in this trial included chemical removal of fruit and severe winter pruning under different irrigation regimes.

The trial was conducted over the consecutive seasons of 2006/07 and 2007/08. During this period the industry oversupply situation improved however vineyard circumstances were not favourable with reduced water availability and longer growing seasons.

Oversupply is no longer in the forefront of grower's minds. While the techniques used in this trial require further investigations regarding chemical registration and maximum residue limits, they could potentially provide relief to growers suffering the impacts of drought, ensuring long-term vineyard viability.

Trial Objectives

1. To investigate potential mothballing techniques in the vineyard and their impacts on future vineyard viability.

2. To observe the impacts of reduced irrigation applications on commercial production.

Site Selection

Site History

The trial site was located in Chardonnay and Semillon planted in 1995, the area of each variety being 0.57 ha Chardonnay and 0.6 ha of Semillon. The Chardonnay was grafted to rootstocks is Ramsey 40, with small plots planted on 140Ruggeri, Schazmann, K5140 , SO4, 110Richter and Ramsey 39. The Semillon was grafted to rootstocks Ramsey 40, Schwarzmann, K5132.

Generally the presence of different rootstocks would be detrimental to trial results, however this trial was designed as a demonstration trial and the different effects caused by rootstocks under mothballing and irrigation treatments highlighted the need to understand specific vineyard circumstances before implementing management strategies.

The vines are planted in 3.5 metre rows with 2.5 metre vine spacing on a two wire vertical trellis, boxed pruned with minimal hand cleanup.

The soil is a sandy loam, varying from 70-105cm top soil depth with a active root depth of 70-75cm and a readily available water of 40-45mm. Soil salinity is between 20-55 mS/m.

The trial sites are irrigated by drip irrigation with dripper outlets spaced every 50cm. Nutrition was applied to the trial sites via fertigation.

The trial sites had been well watered and had a full nutrition program, pest and disease schedule and had a cereal cover crop for the four seasons previous to the trial. Table 1 shows a summary of history for production, water applied and fertiliser.

Year	Chardonnay			Semillon		
	Total Yield T/Ha	Irrigations ML /ha	Fertiliser Kg N per Ha	Total Yield T/Ha	Irrigations ML /ha	Fertiliser Kg N per Ha
1998-99	23.75	3.88	25	24	3.88	25
1999-00	10.56	2.05	40	22.8	2.39	46
2000-01	21.84	4.13	51	27.1	4.13	59
2001-02	27.8	3.45	51	31.4	3.85	63
2002-03	19.9	3.63	51	24.96	3.72	57
2003-04	21.4	3.7	57	31.5	3.4	63
2004-05	26.4	3.2	39	21.6	3.88	35
2005-06		4.48	22		5.4	22
2006-07	16.5	2.7 (1.2)*	10	11.1	2.9	8
2007-08	13.4	2.0 (1.2)*	15	10.3	2.3	14

Table 1: Summary of production, water applied & Nutrition
* Low water management strategy ML/Ha is listed in brackets.

Method

Trial Design
Following is a description of the trial design in the Chardonnay and the Semillon sites.

Chardonnay
In the chardonnay site, eight rows were selected to conduct the trial. Four rows received a high water (50% of normal water application) management and four rows received a low water management (25% of normal water application). The two middle rows of each water management area were used for the application of mothballing treatments, with the outer two rows acting as a buffer zone. Treatments were applied randomly and all treatments described below were present in the high and low water management areas. This patch was barrel pruned both seasons.

Semillon
The trial treatments were also applied to one row of the Semillon to investigate variety effects. Treatments were applied randomly and were barrel pruned both seasons.

Treatments
Following is a description of the treatments applied, refer to the trial map located in Appendix 1 for placement of treatments. All replicates each contained two vines. Photos illustrating treatment application can be seen in Appendix 2.

Season 1 (2006/07)

Treatment	When	How	Replicates	Comments
Chardonnay				
Control			4	Vines were barrel pruned
Heavy Pruning	Late August	Hand pruned back to the cordon	4	Vines were pruned using hand held loppers and small hand saws.
Calcium Nitrate 1	4 leaf stage, bunches 3-5cm, caps intact.	Calcium Nitrate was applied to the foliage at a rate of 2.5kg/100L of water, plus 60ml/100L water of Agral wetting agent.	4	The treatment was applied using a hand wand to the point of run off.
Calcium Nitrate 2	4 leaf stage and resprayed 2 weeks after.	Calcium Nitrate was applied to the foliage at a rate of 2.5kg/100L of water, plus 60ml/100L water of Agral wetting agent.	3	The treatment was applied using a hand wand to the point of run off.
Ethrel 1	Majority of bunches reached 50% flowering.	Ethrel was applied to the foliage at a rate of 50ml/100L of water, plus 60ml/100L water of Agral wetting agent.	4	The treatment was applied using a hand wand to the point of run off.
Ethrel 2	Majority of bunches reached 50% flowering and resprayed when the majority of remaining bunches reached 90% fruit set.	Ethrel was applied to the foliage at a rate of 50ml/100L of water, plus 60ml/100L water of Agral wetting agent.	4	The treatment was applied using a hand wand to the point of run off.
Gibberellic Acid (GA)	Majority of bunches reached 100% flowering.	GA was applied to the foliage at a rate of 50 ppm plus 60ml/100L water of Agral wetting agent.	3	The treatment was applied using a hand wand to the point of run off.
Sulphur & oil	Majority of bunches reached 100% flowering, at the hottest time of the day.	The spray applied to the foliage at a rate of 600g/100L of water plus 1.5% oil.	3	The treatment was applied using a hand wand to the point of run off.

Treatment	When	How	Replicates	Comments
Semillon				
Control			2	Vines were barrel pruned
Calcium Nitrate 1	4 leaf stage, bunches 3-5cm, caps intact.	Calcium Nitrate was applied to the foliage at a rate of 2.5kg/100L of water, plus 60ml/100L water of Agral wetting agent.	6	The treatment was applied using a hand wand to the point of run off.
Calcium Nitrate 2	4 leaf stage and resprayed 2 weeks after.	Calcium Nitrate was applied to the foliage at a rate of 2.5kg/100L of water, plus 60ml/100L water of Agral wetting agent.	2	The treatment was applied using a hand wand to the point of run off.
Ethrel 1	Majority of bunches reached 50% flowering.	Ethrel was applied to the foliage at a rate of 50ml/100L of water, plus 60ml/100L water of Agral wetting agent.	2	The treatment was applied using a hand wand to the point of run off.
Ethrel 2	Majority of bunches reached 50% flowering.	Ethrel was applied to the foliage at a rate of 100ml/100L of water, plus 60ml/100L water of Agral wetting agent.	2	The treatment was applied using a hand wand to the point of run off.

Season 2 (2007/08)

Treatment	When	How	Replicates	Comments
Chardonnay				
Control			4	Vines were barrel pruned
Heavy Pruning	August	Hand pruned back to the cordon	2	Vines were pruned using hand held loppers and small hand saws.
Heavy Pruning - recovery	August	Half the vines that received the heavy pruning treatment in season 1 were barrel pruned only in season 2.	2	The aim was to observe the recovery rate after one season of mothballing.
Calcium Nitrate 1	4 leaf stage, bunches 3-5cm, caps intact.	Calcium Nitrate was applied to the foliage at a rate of 2.5kg/100L of water, plus 60ml/100L water of Agral wetting agent.	4	The treatment was applied using an air blast applied to the point of run off.
Calcium Nitrate 2	4 leaf stage and resprayed 2 weeks after.	Calcium Nitrate was applied to the foliage at a rate of 2.5kg/100L of water, plus 60ml/100L water of Agral wetting agent.	3	The treatment was applied using a air blast to the point of run off.
Ethrel 1	Majority of bunches reached 50% flowering.	Ethrel was applied to the foliage at a rate of 150ml/100L of water, plus 60ml/100L water of Agral wetting agent.	4	The treatment was applied using a air blast spray to the point of run off.
Ethrel 2	Majority of bunches reached 50% flowering.	Ethrel was applied to the foliage at a rate of 100ml/100L of water, plus 60ml/100L water of Agral wetting agent.	4	The treatment was applied using a air blast spray to the point of run off.
Gibberellic Acid (GA)	Majority of bunches reached 100% flowering.	GA was applied to the foliage at a rate of 50 ppm plus 60ml/100L water of Agral wetting agent.	3	The treatment was applied using a air blast spray to the point of run off.
Sulphur & oil	Discontinued in season 2.			

Treatment	When	How	Replicates	Comments
Semillon				
Control			4	Vines were barrel pruned
Heavy Pruning	Mid-August	Hand pruned back to the cordon	2	Vines were pruned using hand held loppers and small hand saws.
Calcium Nitrate 1	4 leaf stage, bunches 3-5cm, caps intact.	Calcium Nitrate was applied to the foliage at a rate of 2.5kg/100L of water, plus 60ml/100L water of Agral wetting agent.	4	The treatment was applied using an air blast spray to the point of run off.
Calcium Nitrate 2	4 leaf stage and resprayed 2 weeks after.	Calcium Nitrate was applied to the foliage at a rate of 2.5kg/100L of water, plus 60ml/100L water of Agral wetting agent.	4	The treatment was applied using an air blast spray to the point of run off.
Ethrel 150	Majority of bunches reached 50% flowering.	Ethrel was applied to the foliage at a rate of 150ml/100L of water, plus 60ml/100L water of Agral wetting agent.	6	The treatment was applied using an air blast spray to the point of run off.

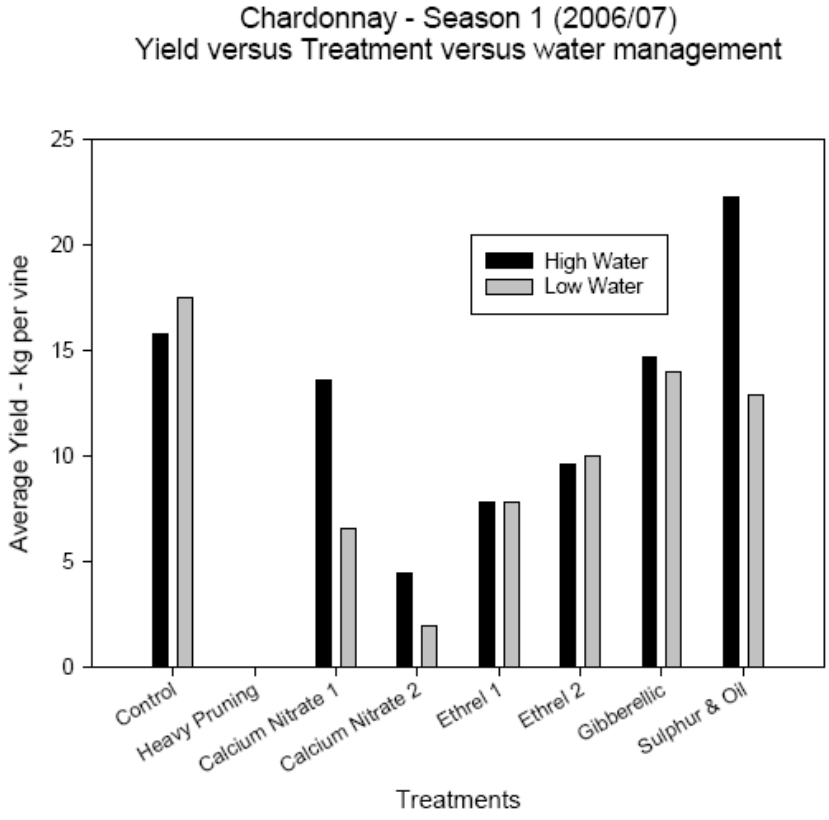
Results & Discussion

Treatments were visually monitored throughout Season 1 (2006/07) and Season 2 (2007/08). Key photos of treatments are attached in Appendix 2

Trials were hand harvested in January in both seasons.

Season 1 - 2006/07

In Season 1, the heavy pruning treatment showed the best results under both high and low water management for reducing vineyard crop load, see graph 1.



Graph 1: Yield results for Chardonnay treatments under different water management in Season 1

The Calcium Nitrate 2 treatment which involved two separate applications at different timings produced the best results for chemical removal methods in this season.

The Ethrel treatments were successful in reducing crop load below the control treatment. Ethrel was initially chosen due to its use as a thinning agent in the apple and citrus industries. A number of different rates were trialled to demonstrate effectiveness, with rates increased in Season 2 (2007/08), to be discussed below.

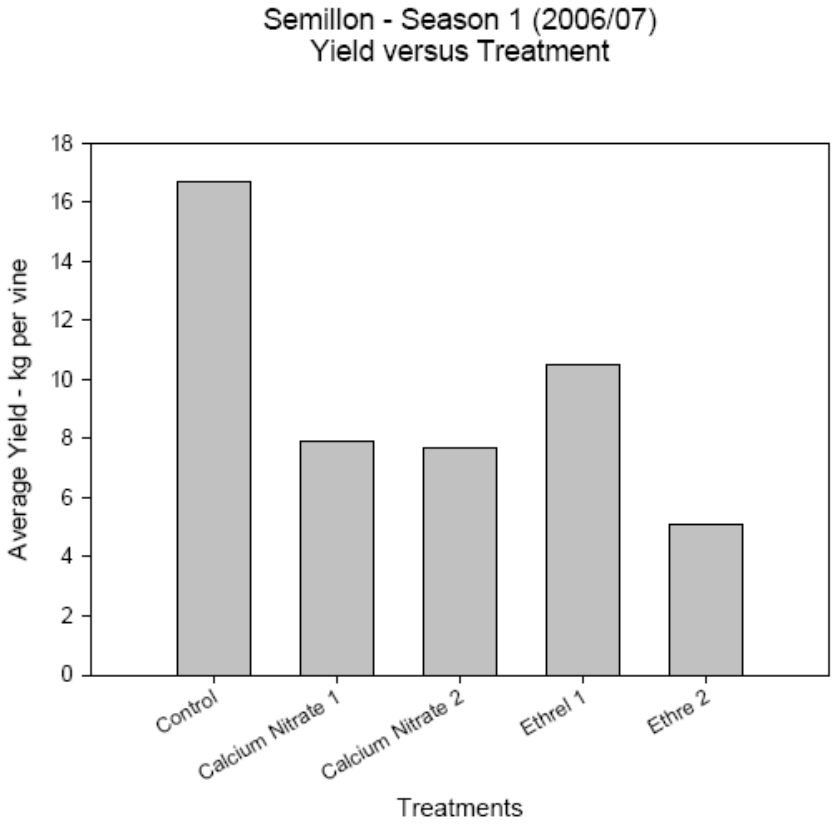
The Giberellic Acid (GA) and Sulphur plus oil treatments both failed to reduce the yield in Season 1.

The GA treatment was initially applied based on some previous work conducted in Germany which reduced berry number for looser bunches and consequently yield (Weynard & Schultz 2005)

The Sulphur plus oil treatment was applied because local growers had reported burning when sulphur was applied at some times of season. This treatment applied at the right concentrations and climatic condition could cause devastating effects to soft tissue foliage and bunches, causing them dry out and fall from the vine.

The Sulphur plus oil treatment was discontinued in Season 2 due to ineffective response seen in Season 1.

The high and low water treatment results were varied and unexpected. It was the expectation that the low water treatment would cause the thinning treatment effect to be magnified and in the case of the control that the low water treatment would have less fruit than the high water treatment due to a higher level of stress. However this was not the case in the control with the low water treatment yielding a higher crop load than the high water treatment.



Graph 2: Yield result for Semillon treatments in Season 1.

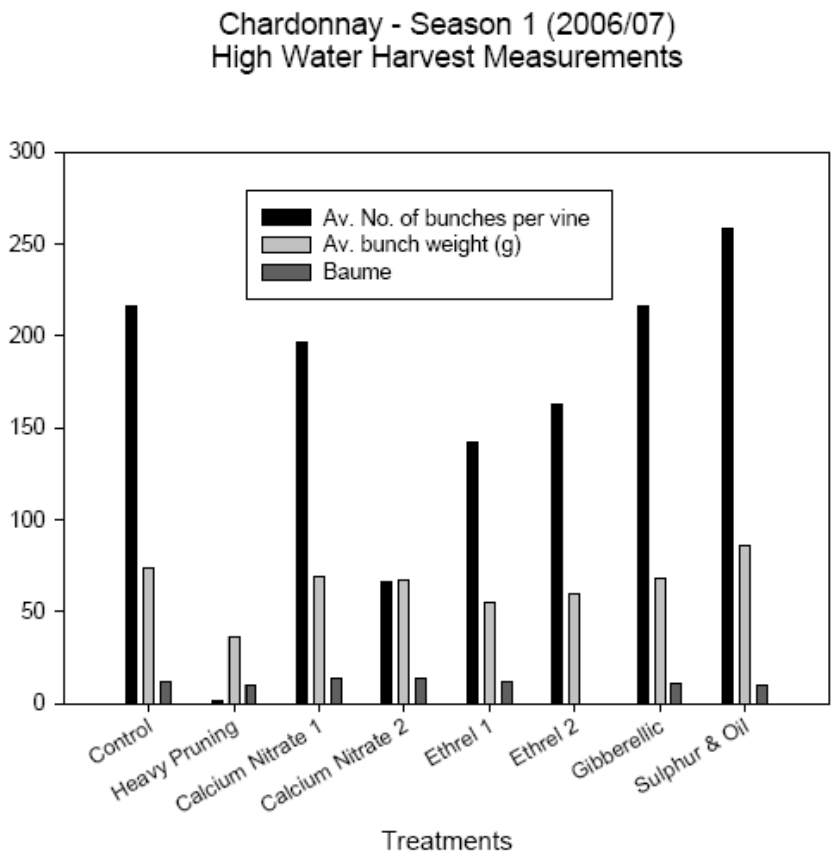
The heavy pruning treatment was not present in the Semillon in Season 1. The results from this trial indicate as was shown in the Chardonnay that the chemical treatments were successful in reducing the fruit load in comparison to the control. The results for the Calcium Nitrate and Ethrel treatments do not reflect the results for these treatments in the Chardonnay.

Results from fruit measurements taken at harvest are illustrated below in Graph 3 & 4.

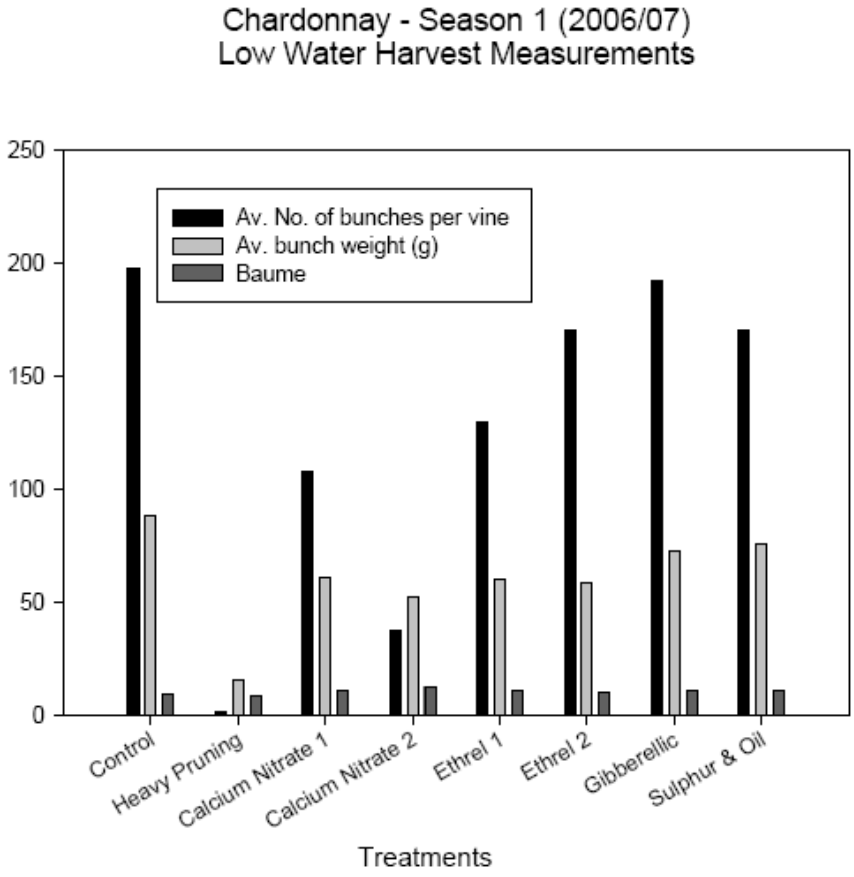
Once again the heavy pruning treatment showed a reduction in number of bunches per vine and average bunch weight in both the high and low water management strategies. This supports the low yield recorded in Graph 1.

The Baume results are relatively similar for all treatments. Note due to an error, the reading for Baume for the Ethrel 2 treatment is absent.

Overall the results support the yield results illustrated in Graph 1.



Graph 3: Harvest measurements for Chardonnay treatments in Season 1 under the high water management strategy.

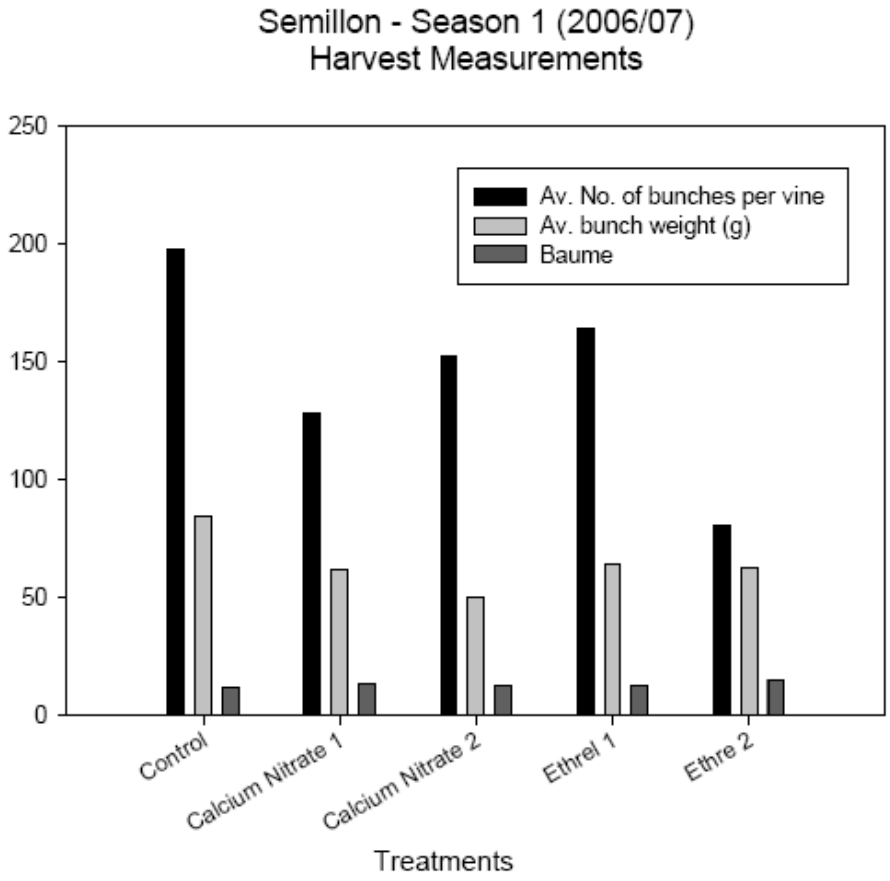


Graph 4: Harvest measurements for Chardonnay treatments in Season 1 under the low water management strategy.

The fruit measurement results for the Semillon, illustrated below in Graph 5 indicate the Ethrel 2 treatment reduced the number of bunches on the vine, while the average bunch weight was similar to the Ethrel 1 treatment. The high average number of bunches and the vines ability to maintain the average bunch weight implies the Ethrel 1 treatment rate was not high enough to be successful in reducing crop load.

Baume readings were similar across all treatments.

The results illustrated in Graph 5 relate and support the yield figures reported in Graph 2.



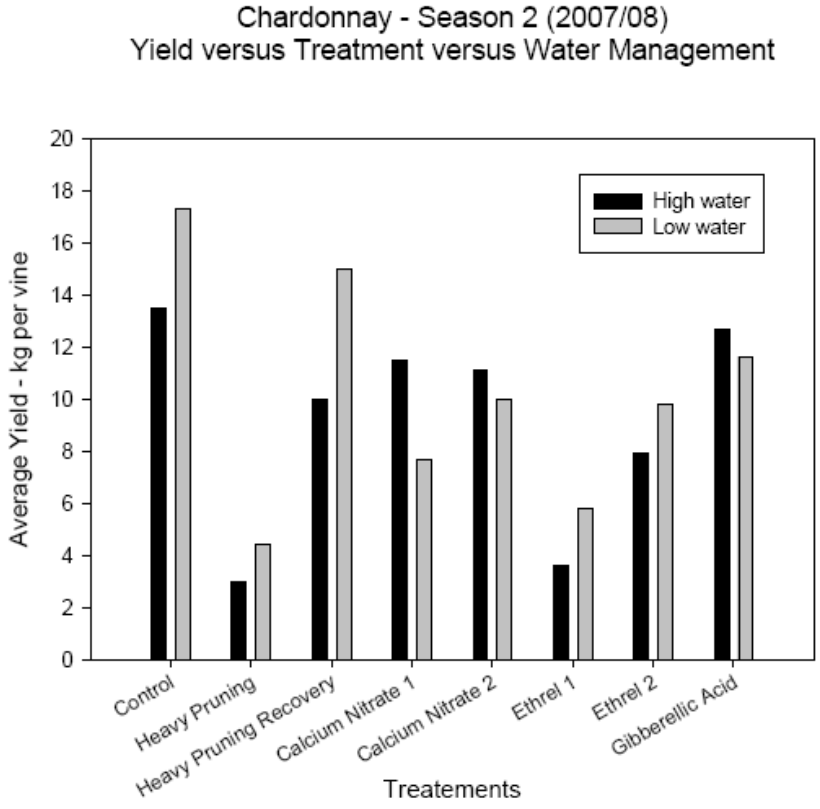
Graph 5: Harvest measurements for Semillon treatments in Season 1.

Season 2 - 2007/08

The results for the 2007/08 season in the Chardonnay treatments are illustrated below in Graph 6. These results show the mechanical and chemical treatments were successful at varying levels in reducing vineyard crop load.

The heavy pruning treatment again produced the best results in reducing crop yield, though the results were not as dramatic as Season 1 which produced less than 1kg in yield per vine.

The heavy pruning recovery treatment which was barrel pruned only in Season 2 to evaluate the recovery rate of this treatment showed positive yield results. These results indicate that heavy pruning would be a good option for reducing crop load for one season and would recover well in the second season. This treatment also provided the opportunity to restructure the canopy and remove old dead wood.



Graph 6: Yield results for Chardonnay treatments under different water management in Season 2.

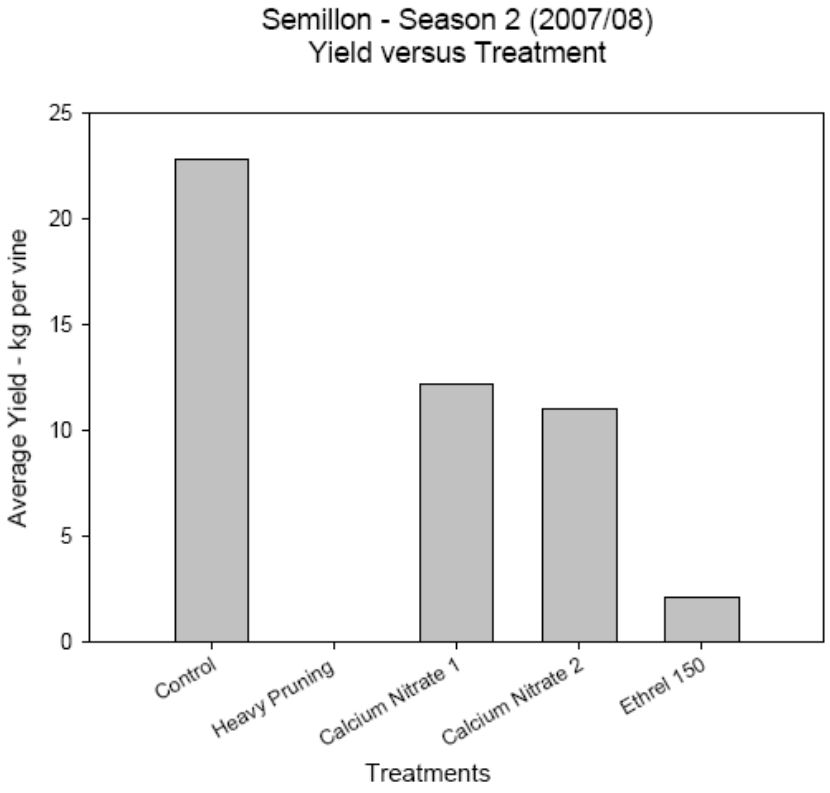
Treatments Calcium Nitrate 1 and Calcium Nitrate 2 produced inconsistent results in comparison to Season 1. Timing of application and climatic conditions impact the success of this mothballing treatment. The re-spray application of Calcium Nitrate did not result in a low yield as it had done so in the previous year.

The Ethrel treatments were both applied in a single application in season 2, with a change in rate for Ethrel 1, successfully resulted in reduced crop yield.

GA showed a better result in reducing crop load in the second season, though it was only slightly below the control results. Climatic conditions and timing of application would have the greatest impact on the outcome of this treatment.

The high and low water treatments once again produced mixed results and did not support the theory that reduced water applications would magnify the effect of a treatment.

The yield results for the Semillon in season 2 shown below in Graph 7 indicate that the heavy pruning treatment is the best option for reducing crop load in the vineyard. The increased rate of Ethrel produced the best results in the chemical treatments though all chemical treatments were successful in reducing crop load.

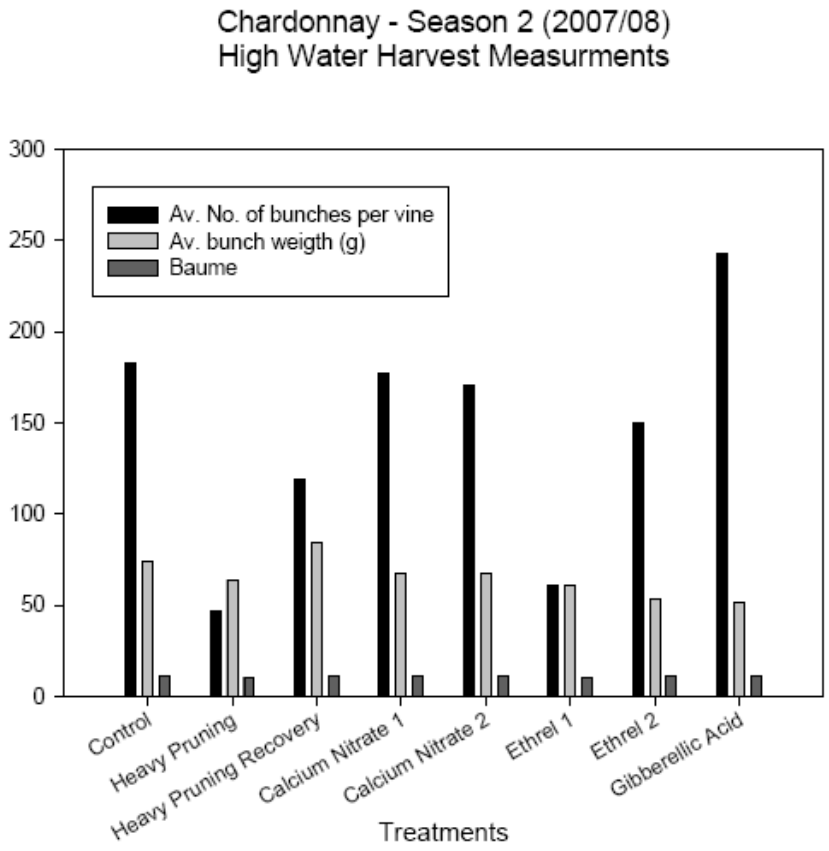


Graph 7: Yield result for Semillon treatments in Season 2.

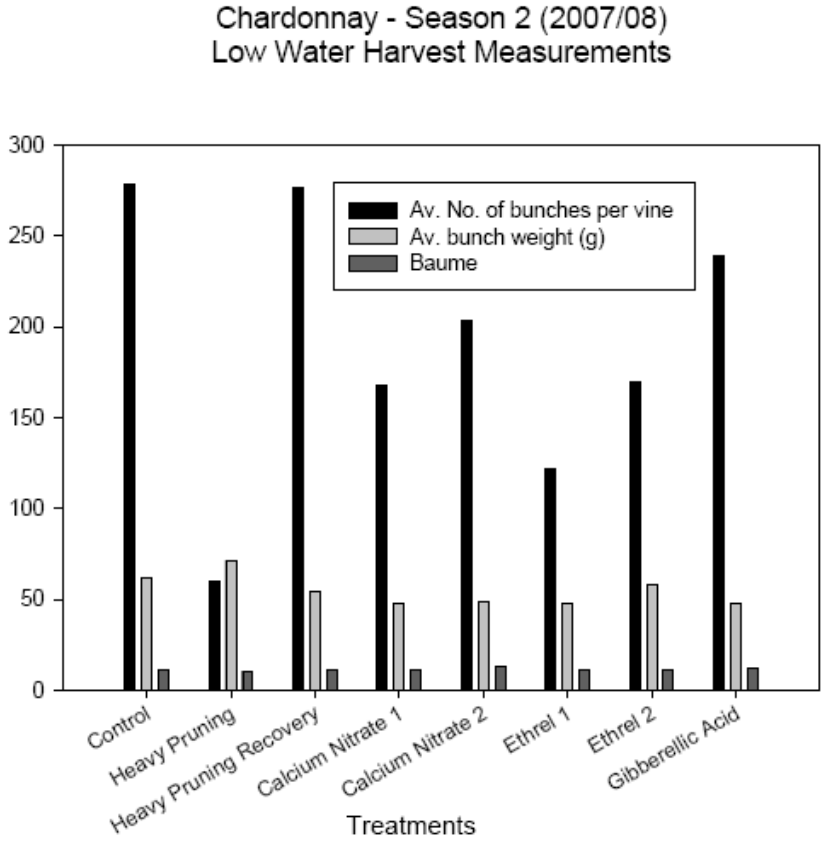
The Chardonnay harvest measurements for the second season are shown below in Graph 8 and 9, high water and low water management strategies respectively.

The harvest measurements illustrate the relationship between average number of bunches and average bunch weight in relation to yield. Baume once again was relatively similar across the board.

Overall the results showed nothing out of the ordinary.

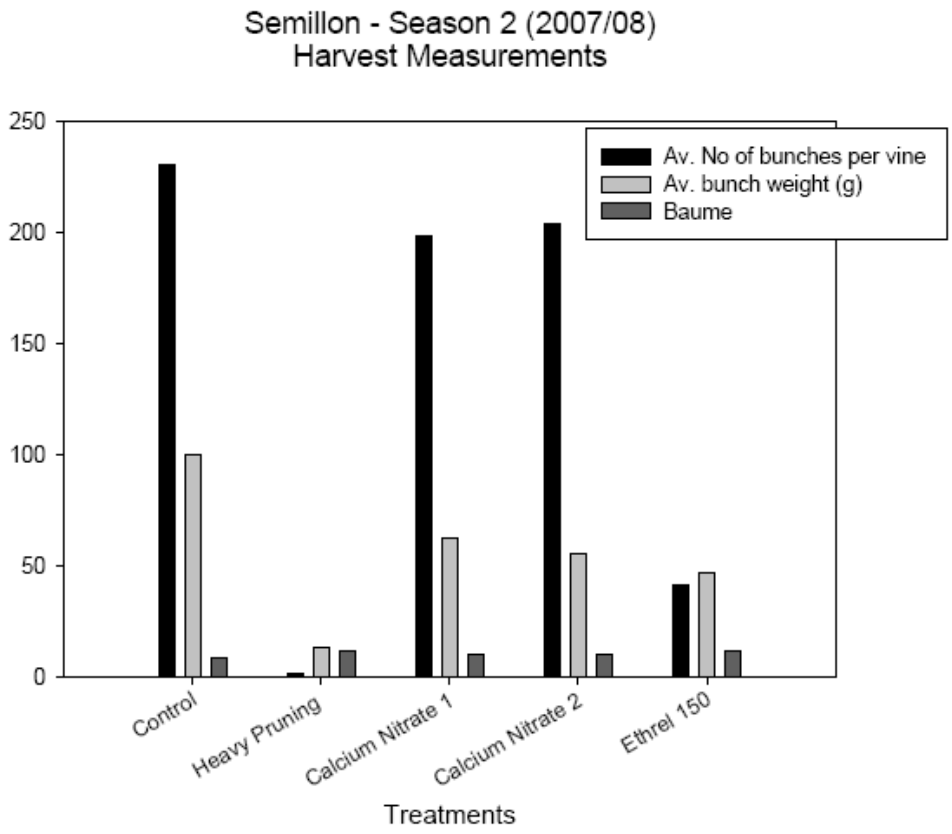


Graph 8: Harvest measurements for Chardonnay treatments in Season 2 under the high water management strategy.



Graph 9: Harvest measurements for Chardonnay treatments in Season 2 under the low water management strategy.

The harvest measurements for the Semillon in the 2007/08 (see below in Graph 9) season paint a comparable picture to the chardonnay results in that the heavy pruning retained the least number of bunches per vine and the increased Ethrel rate performed better than those used in season 1. The Calcium Nitrate treatments were able to reduce the number of bunches retained and the average bunch weight was lower than the control due likely to reduced number of berries retained per bunch.



Graph 10: Harvest measurements for Semillon Treatments in Season 2.

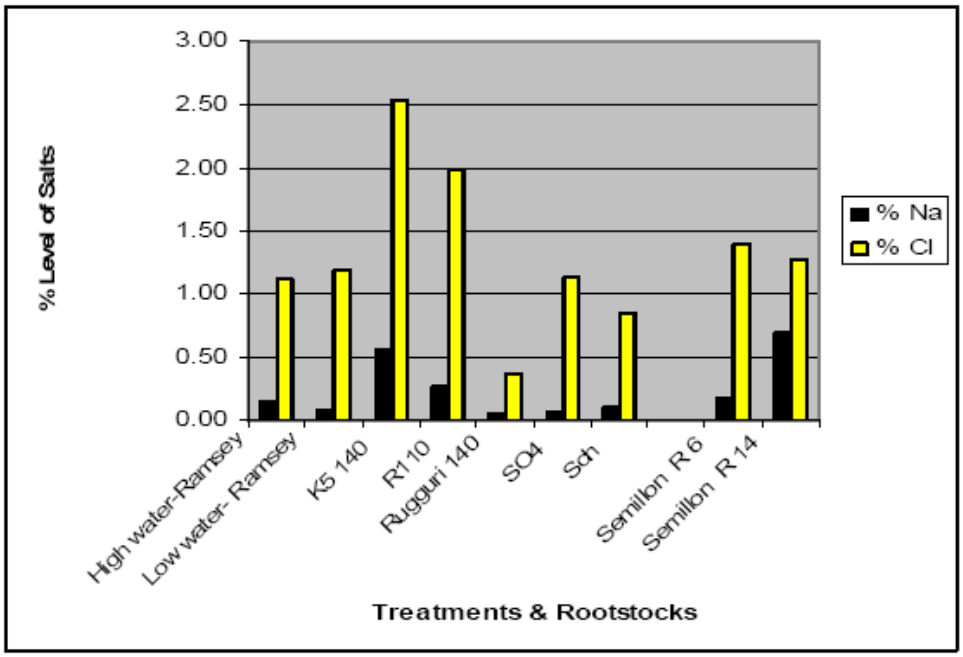
While the high and low water management strategies did not impact on mothballing treatments as expected, they did have the expected results of rising salt levels under reduced water application as seen below in table 2.

Results of Soil Salinity 2007& 2008								
		Aug-07				Jul-08		
site location	texture	salinity	pH	Lime	texture	salinity	pH	Lime
		dS/m				dS/m		
Chardonnay								
Low water								
30cm	SCL				SCL	0.80		
60cm	CL	0.67	7.9	S	CL	0.82	7.9	S
90cm	CL	2.19	8.8	V	CL	1.02	8.8	V
High water								
30cm	SCL				SCL	1.01		
60cm	CL	0.87	8.1	S	CL	1.40	8.1	S
90cm	CL	2.59	8.6	V	CL	3.23	8.6	V
Semillon								
30cm	SCL				SCL	0.54		
60cm	CL	0.92	8.7	N	CL	1.49	8.7	N
75cm	SCL	1.45	9	N	SCL	2.55	9	N
90cm	CL	3.30	9.2	V	CL	3.11	9.2	V

Table 2: Soil Salinity records for trial site in Season 1 and Season 2.

The increase in soil salt levels is expected to correspond to a potential increase in vine salt levels. Graph 11 below illustrates vine salt levels for the different water management strategies in the Chardonnay and for a number of different rootstocks.

Rootstocks characteristics provide vines with varying threshold resistance to salt stress. Rootstock K5140 has a low threshold for salt stress which can be seen below and was evident in the vineyard with vines displaying leaf burn, leaf drop and fruit which would not ripen. See Appendix 2 for photos.



Graph 11: Vine salinity records for treated vines in Season 2 based on rootstock.

Conclusion

Growers should consider their own specific situations before implementing any of the techniques described in this document.

As has been suggested, timing of application, rate and climatic conditions will have an impact on your ability to reduce vineyard crop load.

Reduced water treatments have been shown to have mixed results and did not magnify the impact of the treatment as was expected.

Where water applications were reduced, trial results strongly suggest soil salinity and vine salt levels may rise with each year this treatment is imposed. Soil and plant analysis will be useful tools for growers to monitor vineyard salt stress.

The heavy pruning treatment was able to reduce the production per vine and could potentially be used on vines for two seasons without causing significant consequences for vineyard recovery. Consideration needs to be made to the labour and cost inputs for this method of Mothballing to reduce crop loads.

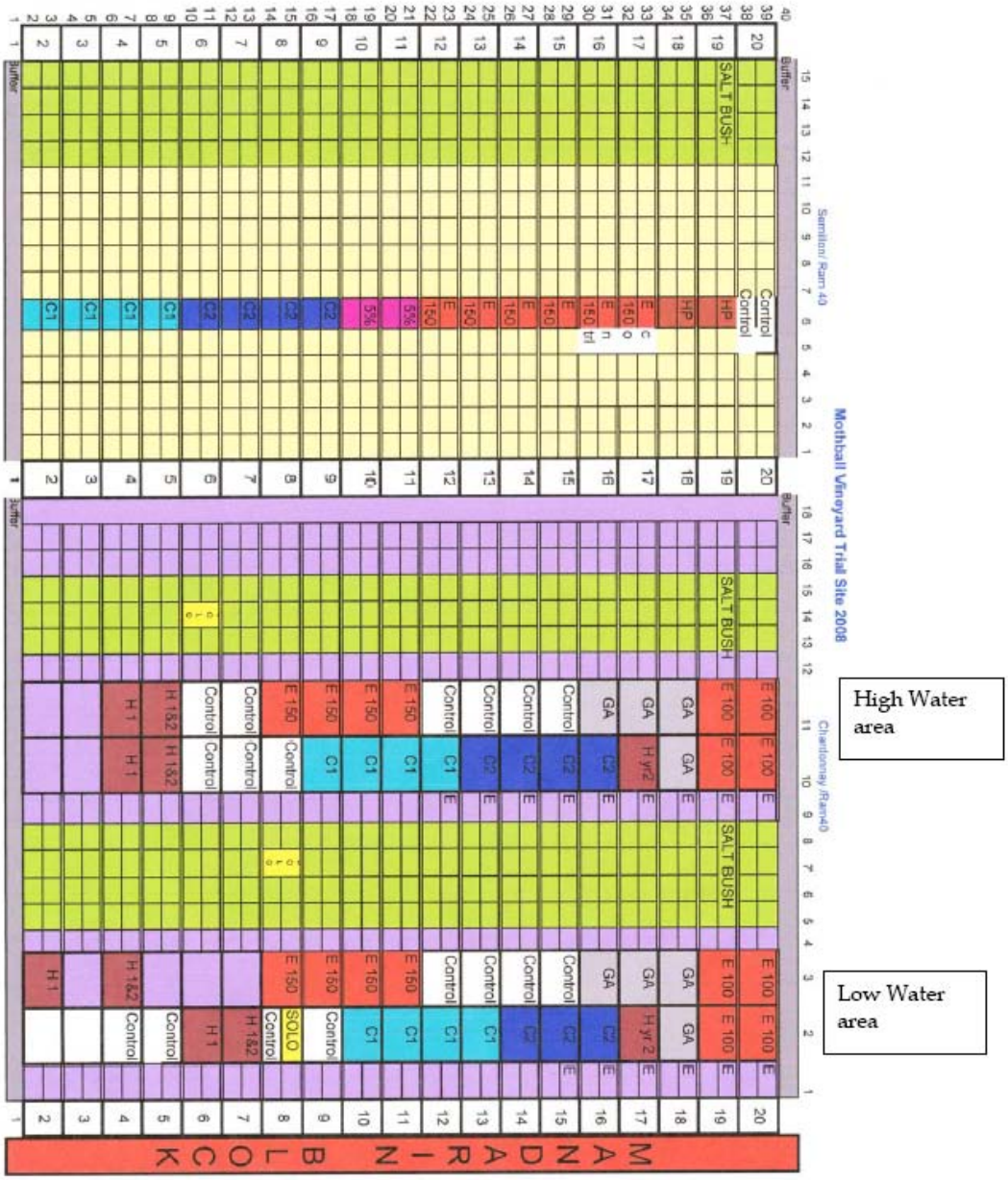
The Ethrel treatment was successful at reducing crop load however further consideration needs to be made to rates, timing and chemical registration.

Chemical registrations will impact on grower's ability to implement mothballing treatments; the chemicals used in this trial are not registered for this purpose.

Growers should be aware that NSW DPI, Murray Valley Winegrowers' Inc and GWRDC are not able to recommend specific mothballing treatments; they do not guarantee results and are not liable for grower's actions and / or losses caused from the implementation of the techniques described in this document.

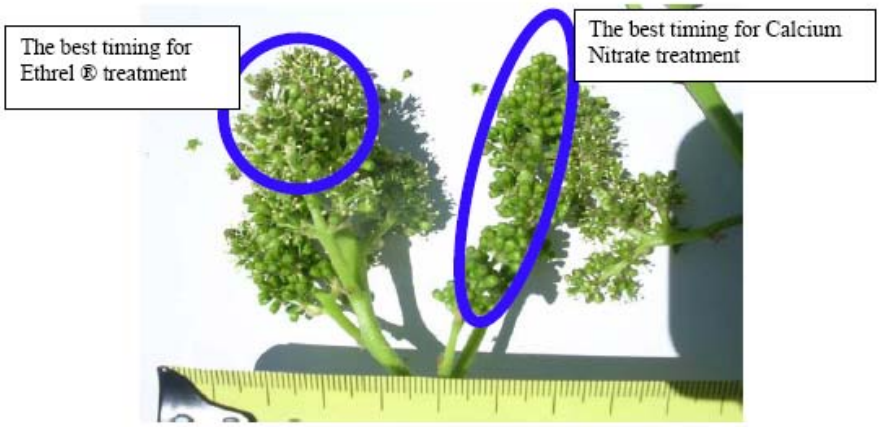
The aim of this trial was to collect information on potential mothballing techniques.

Appendix 1 – Trial Design



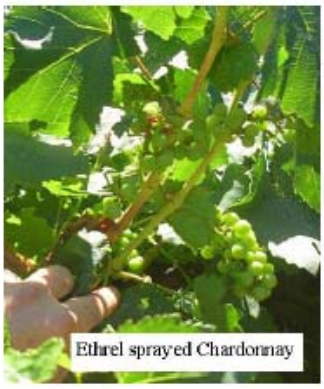
Appendix 2 – Trial Photos

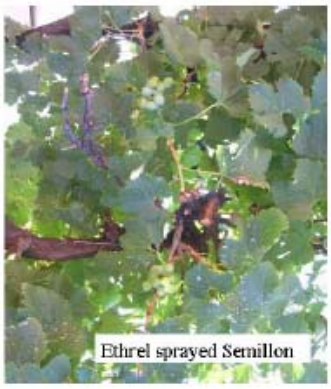




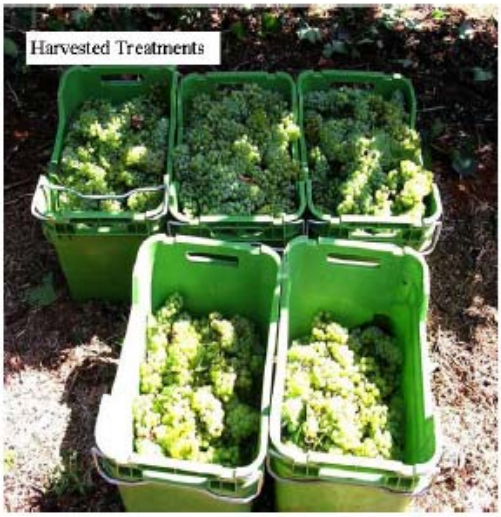





Ethrel sprayed Chardonnay


Ethrel sprayed Semillon

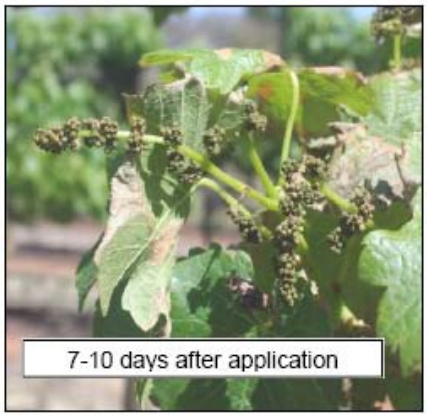

Hand Harvesting


Harvested Treatments

Heavy Pruning



Calcium Nitrate







Ethrel











APPENDIX 5 – Mothballing Publication

Mothballing the Vineyard - Actions & Impacts



NSW DEPARTMENT OF PRIMARY INDUSTRIES

Australian Government
Grape and Wine Research and Development Corporation

Murray Valley Winegrowers' Inc

Mothballing the Vineyard

What is Mothballing?

To maintain a non-producing vineyard with minimum but critical inputs to allow a rapid return to cropping for productive use / sale in the future when the industry situation has improved.

Potential Techniques

In a GWRDC funded project, Murray Valley Winegrowers in co-operation with NSW DPI trialled a number of potential techniques for Mothballing the Vineyard.

The techniques were trialled under high (2.7ML/Ha) and low (1.2ML/Ha) water management strategies to investigate the impact of changing inputs.

Heavy pruning

Vines in this treatment were hand pruned back to the cordon in the 2006/07 season during dormancy. In the 2007/08 season half the replicates of this treatment were barrel pruned only to investigate recovery rate while the remaining replicates were pruned back to the cordon for a second season. As can be seen in the results on the opposite page, the heavy pruning treatment was successful at reducing crop load in both seasons and the vines recovered quickly after one season of imposed treatment.

Calcium Nitrate

Calcium Nitrate was foliar applied to vines at the early 4 leaf stage when bunches were approximately 3-5cm in size with caps still intact. Treatment "Calcium Nitrate 2" had a second application applied 2 weeks after the first. The aim was to desiccate the bunches while they were still in the soft tissue stage. Results indicate that Calcium Nitrate was able to reduce vineyard crop load though growers should be conscious of chemical registration requirements.

Ethrel

Ethrel was foliar applied when the majority of bunches reached 50% flowering. Ethrel treatments varied in rates and number of applications, however as can be seen from the results excluding Ethrel 1 in the 2006/07 season when the rate was deemed to be low, all Ethrel treatments were successful in reducing vineyard crop load. This chemical was selected based on its registration for thinning in the apple / citrus industry, however winegrape growers are warned that Ethrel **DOES NOT** have registration in winegrapes for mothballing purposes.

Giberellic Acid (GA)

GA was foliar applied when the majority of bunches reached 100% flowering. The aim of this application thin the bunches reducing the crop load, however while the treatment did reduce the vineyard crop load in the 2007/08 season as shown in the results, it was unsuccessful in the 2006/07 season.

Sulphur & Oil

The use of a high Sulphur rate combined with oil, foliar applied in the hottest part of the day when the majority of bunches reached 100% flowering was designed to burn bunches. However it was deem largely unsuccessful and was discontinued after the 2006/07 season.

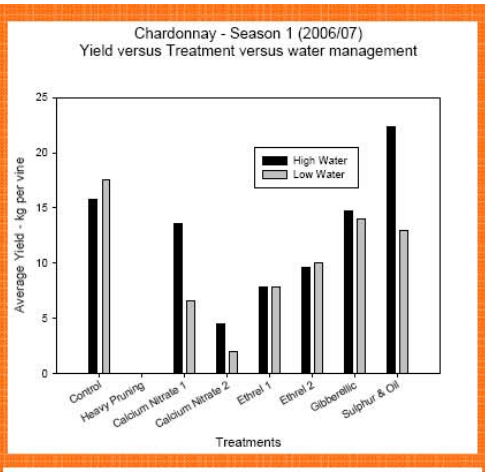
Checklist

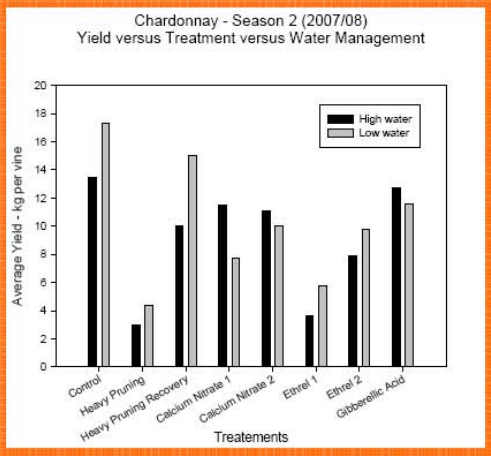
Accurate information is critical for good decision making. The checklist on the back page of this publication aims to outline areas for further investigation, to ensure you have sufficient information to make hard decisions that have a future in times of oversupply.

Further Information

For further information please contact Gregory Moulds, District Viticulturalist for NSW DPI on (03) 5027 4409 or Liz McGuire, Industry Development Officer for Murray Valley Winegrower's Inc on (03) 5021 3911.

Disclaimer: The information provided in this publication documents results and/or impacts specific to a controlled and isolated trial. Murray Valley Winegrowers' Inc., NSW DPI and /or GWRDC make no recommendations, nor do they guarantee this information and are not liable for your actions and / or losses should you implement any techniques described in this document.





Heavy Pruning



Ethrel



Typical spray damage



Calcium Nitrate



7-10 days after application



33 days after application

Photo material supplied by Gregory Moulds, NSW DPI

CHECKLIST	Yes	No	more info
Financial management			
Do you have production records detailing income and costs?			
Do you have a farm business plan and annual budgets?			
Have you calculated the cost of the "do nothing" option?			
Do you require financial skills training or professional assistance?			
Have you investigated the assistance and/or exit strategies available through Sunraysia Rural Counselling Service?			
Marketing fruit			
Do you have a schedule of current contracts and expiry dates?			
Have you considered the likely requirement for your varieties in the medium to long term?			
Are you aware of your grape purchaser's future requirements and the industry supply demand outlook?			
Have you developed a business portfolio that provides potential buyers with essential information?			
If you have a current contract, have you considered strategies to sell fruit without a contract?			
Property Planning / Records			
Have you prioritised each block on a productivity / return / cost basis?			
Have you determined which varieties are of no commercial value to you?			
Can you prioritise one/few variety/varieties that is/are commercially valuable to you and maintain best viticultural practices?			
Have you been doing some market research to ascertain any variety trends?			
Pruning			
Do you know the costs of your existing pruning program?			
Have you ascertained what level of pruning is required next season to achieve the required cropping levels?			
Do you need to prune vines harder to reduce cropping load next season?			
Thinning			
Do you need to remove or reduced crop load next season?			
Have you calculated the cost : benefit of crop removal or thinning next season ?			
Have you calculated yield / ha required for each variety?			
Can you control crop load and vigour with irrigation practices with the existing irrigation system?			
Have you considered the impact removing next seasons crop will have next season and subsequent seasons?			
Irrigation			
Have you developed a water budget for EACH patch?			
Have you considered what impact a reduced water application will have on yield, vine health and vine productivity?			
Could you make savings by investing in improved system and/or scheduling equipment or management?			
Nutrition			
Are you using the most cost effective forms of required inputs available?			
Can you reduce or delay inputs?			
Pest and Disease Management			
Have ascertained the minimal inputs required to provide acceptable level of control?			
Can you use cheaper chemicals to achieve acceptable level of control?			
Have you considered the disease risks if fruit is left on the vine?			
Have you considered neighbouring properties when considering practice change?			
Alternative management			
Have you considered removing vines from production through mothballing or vine removal?			
Have you considered growing alternative crops? Is you property suitable?			
Have you considered the impact of mothballing?			
Have you considered mothballing techniques that could be used in the vineyard?			
Have you considered how long your vineyard can be mothballed?			
Have you considered how quickly a mothballed vineyard will recover and return to production?			
Could you leave fruit on the vines at harvest and removing it at pruning?			

APPENDIX 6 – Mothballing Presentations

1. ASVO Berri & Griffith- Tools for managing crop load
2. Riverlink Mothballing the vineyard impacts &actions
3. Murray Darling Technical group- Crop Removal Trial 2006

Tools For Managing Crop Load.

Murray Valley Winegrowers Inc

Presented by Gregory Moulds, NSW DPI & John Crocker SARDI

Griffith, Friday 11th May 2007

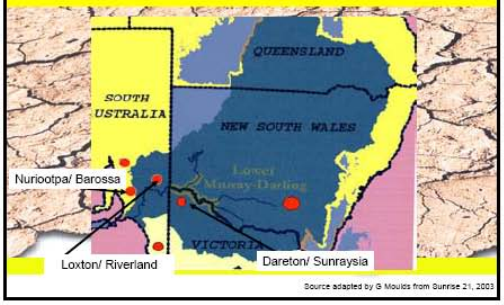
Presentation Outline

- Background
- Outline of research in South Australia & Dareton
- Results and treatment costs
- Comments and questions…

Climatic & Market Extremes



Trial Regions



Source adapted by G Moulds from Sunrise 21, 2003

Treatments / SA & NSW

- Heavy winter pruning
- Manual crop thinning at flowering
- Sprays at flowering including…
  - Calcium nitrate
  - Ammonium Thiosulphate
  - Gibberellic acid
  - Ethrel®**
  - Sulphur plus oil
- Severe summer pruning after flowering

(** Not currently registered for use)

Reduced Water Treatments

- Loxton
  25%, 60% & 100%
- Nuriootpa
  No water & 60%
- Dareton
  100% & 50% (48% of allocation)



4.

Measurements

- Flowering data
- Bunch number per vine at harvest
- Average Bunch weight & yield per vine at harvest
- Bud dissections (April)
- Pruning weights (July)

Heavy Pruning-dormant/before sap flow



Heavy Pruning-Observations

- Most arms re-shoot well
- Typically 40 -50 shoots per vine in NSW, 20 to 30 in SA
- 0-5 small bunches per vine
- At harvest:
  - Virtually no crop
  - With 50% or 60% water, canopy was similar to normal winter pruning



Bunch Development at Spraying



Spraying (Calcium Nitrate) 2.5kg per 100L





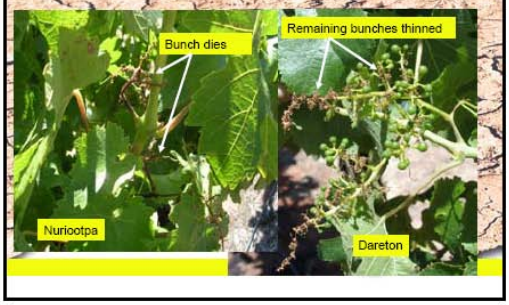
Bunches 33 Days (Cal Nitrate)



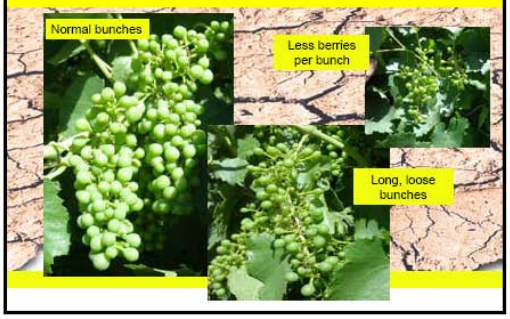
Ethrel® - Spraying @ 50 &100mls

- Applied at full bloom: 24th of Oct (NSW), 6th Nov (Nuri) & 17th Nov 06 (Loxton)
- First signs of result after 7 days
- Berry drop continued for 5-7 days
- At least 45% reduction of bunch numbers
- Reduced berry numbers in surviving bunches

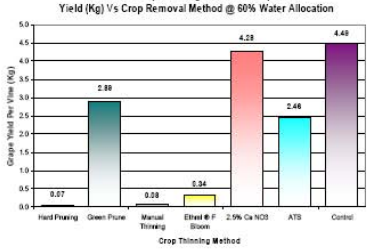
Ethrel® - Sprays, Typical Results



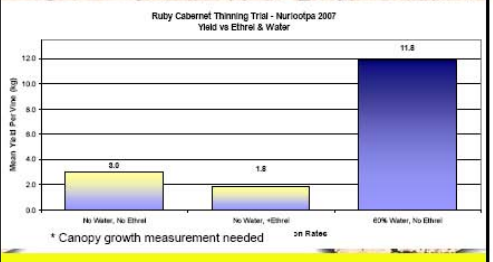
Gibberellic Acid (Dareton)@ 50ppm



Trial Results - Nuriootpa



Trial Results - Nuriootpa



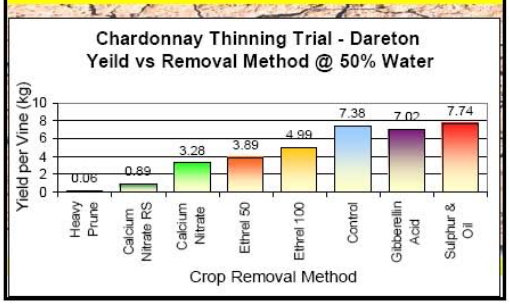
* Canopy growth measurement needed

Bunch Comparison at Harvest-S.A.



h

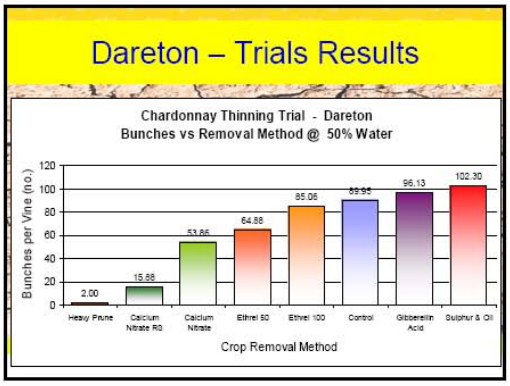
Dareton – Trials Results



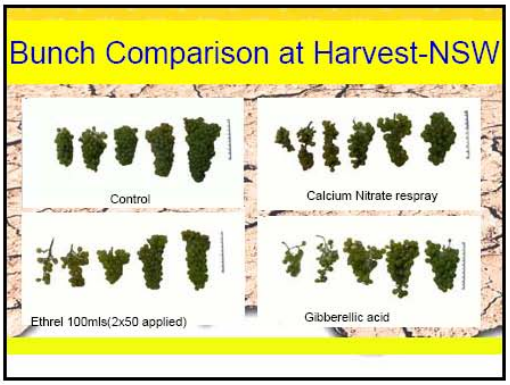
Fruit at harvest-Control vs Ethrel®



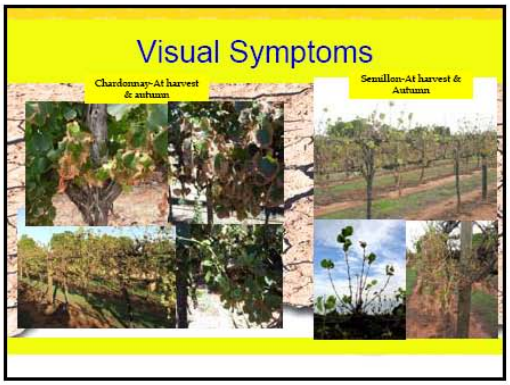
Dareton – Trials Results



Bunch Comparison at Harvest-NSW



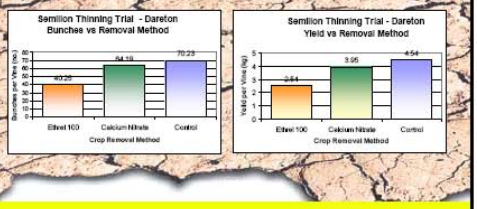
Visual Symptoms



History of Yield & Water -Chardonnay

Chardonnay	Yield (t/acre)	Irrigation (ML/Ha)
1998-99	9.9	3.88
1999-2000	4.4	2.06
2000-01	9.1	4.03
2001-02	11.6	5.46
2002-03	8.3	3.63
2003-04	8.9	3.7
2004-05	11	3.2
2005-06	* left on vine	4.48
2006-07-100%	7.9	2.2
2006-07-50%	6.7	1.2

Dareton – Trials Results



Bunches at harvest -Semillon



History of Yield & Water-Semillon

Semillon	Yield (t/acre)	Irrigation (ML/Ha)
1998-99	10	3.88
1999-2000	9.5	2.39
2000-01	11.3	4.13
2001-02	13.1	3.85
2002-03	10.4	3.72
2003-04	12.9	3.4
2004-05	9	3.88
2005-06		5.4
2006-07-100%(2.2mg/ha)	5.5	2.2

Best Crop Reduction Methods:-

1. Heavy winter pruning
2. Ethrel sprays – 100ml or 150ml/100L
3. Double application of calcium nitrate
4. Reduced water application combined with one of above

- More research needed to understand carryover effects on crop & growth
- Dareton trial -for more 2 years

Costs of Pruning & Sprays

- Initial machine prune $ 280 / ha
- Hand prune est. cost $2400/ ha
- Ethrel Spray ($21/$32) $120/ ha**
- Calcium Nitrate $20-40/ha **
- Commercial contract rates:-(Ethrel® @ $50 per ha & Cal Nitrate @ $220 per ha)
- **varies with available machinery

Take Home Messages:-

- Heavy winter pruning & manual bunch thinning are best, but they are expensive.
- Heavy winter pruning provides an opportunity to renovate and revitalize vineyard canopies while production is minimised.



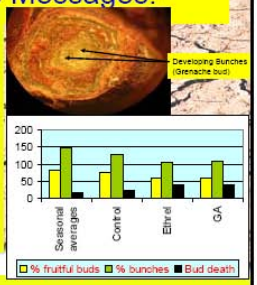
Take Home Messages:-

- Area in better situation than Dareton / Sunraysia was in NSW 2006.
  - There is time to plan!!
  - No surplus crop, & no un-certainity of home for fruit!!
- There growers had reached fruit set stage , then 48% Allocations came!!
  - Plan,
  - Avoid selling water off!!
  - You will have more knowledge to make decisions.
- Go away after today & plan your future management decisions.



Take Home Messages:-

- Ethrel ® at flowering: 100 – 150ml/100L @ 1000L/ha, provided excellent, cost-effective crop removal
- The 150ml rate also reduced shoot growth at Nuri.
- Bud dissection results-Dareton vines indicate a reduced fruitfulness, with sprays of Ethrel ® or Gibberellic acid



Take Home Messages:-



"IN THE MURRAY BASIN IT IS THE POWER OF WATER!!"

1. Manual or chemical crop removal may improve the chances of vineyard survival if no water is available.
2. Small owner operators could choose heavy pruning & do at own pace.
3. If a small water allocation is available, crop thinning may permit the allocation to be rationed or redirected to high value varieties or blocks at greatest risk

Thanks For Support:-

- Liz McGuire - Murray Valley Wine Growers
- John Crocker-SARDI, Lenswood, S.A.
- Michael McCarthy – SARDI
- Michael Treeby – CSRIO -Merbein
- Tim Smythe - Riverland Wine
- Staff at Griffith office of NSW DPI
- April Winckel – Winckel & Associates Management Services
- SARDI Staff & NSW DPI Staff

NSW DEPARTMENT OF PRIMARY INDUSTRIES

Murray Valley Winegrowers' Inc

•Funding provided by GWRDC

MOTHBALLING THE VINEYARD: IMPACTS & ACTIONS



Prepared by Gregory Moulds - NSW DPI

Liz McGuire - Murray Valley Winegrowers Inc

Riverlink Winegrape Symposium – June 14 2007

Murray Valley Winegrowers Inc | NSW DEPARTMENT OF PRIMARY INDUSTRIES | RIVERLINK

Presentation Outline

- Situation at the time – oversupply
- Background of project
- Actions & outputs to date
- Trials in NSW & SA
- Treatment & Results
- Take home messages
- Comments and questions…

Situation at the time Market Extremes & Climatic



Taking the bull by the horn

- Seminar held in the lead up to 2006 season
- Excellent speakers provided forward thinking!

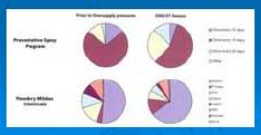


GWRDC RITA project

- **Actions**
  - Literature review
  - Grower Interviews
  - Industry Forum
  - Trial sites
  - Extension to growers & industry
  - Practical publication
  - Seminar

Grower survey 2005-06

- Measuring the impact oversupply on vineyard management & practices
- Approximately 400 returns
- Results in MVWI "Grapevine" magazine



Industry Forum

- Industry representatives, viticultural consultants & industry scientists
- Potential techniques included:
  1. **Chemical removal of fruit,**
  2. **Physical removal of fruit,**
  3. **Minimal input,**
  4. **Severe winter pruning,**
  5. Cutting cordons - the vine below the cordon OR removing the top cordons,
  6. Irrigation stress at flowering and,
  7. Zero input.

Trials

- Treatments developed from forum
- Collaboration between NSW DPI & SARDI
- Trial site located at NSW DPI - Dareton, Loxton & Nuriootpa



Regular updates



Treatments

- Heavy winter pruning
- Sprays at flowering including…
  - Calcium nitrate
  - Gibberellic acid
  - Ethrel®**
  - Sulphur plus oil
  - Ammonium Thiosulphate
- Manual crop thinning at flowering
- Severe summer pruning after flowering

(** Not currently registered for use)

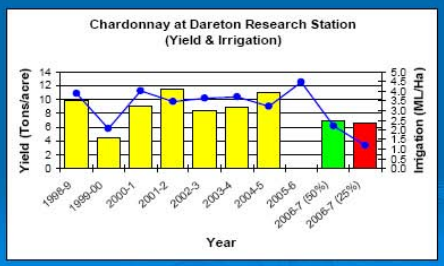
Reduced Water Treatments

- Loxton
  25%, 60% & 100%
- Nuriootpa
  No water & 60%
- Dareton
  100% & 50% (48% of allocation)

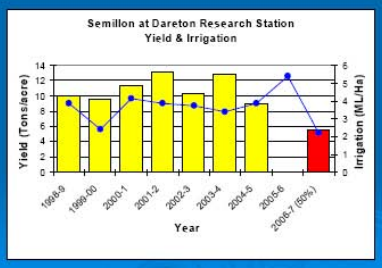
Became 50% and 25% of normal seasonal irrigations



Yield & Water -Chardonnay



Yield & Water -Semillon



Measurements

- Flowering data
- Bunch number per vine at harvest
- Average Bunch weight & yield per vine at harvest
- Bud dissections (April/May)
- Pruning weights (July)

Heavy Pruning



Heavy Pruning-Observations

- 40 -50 shoots / vine in NSW
- 20 to 30 shoots / vine in SA
- 0-5 small bunches per vine
- At harvest:
  - Virtually no crop
  - With 50% or 60% water, canopy was similar to normal winter pruning
  - Soft new growth

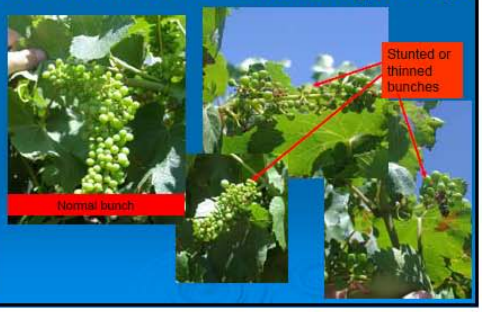
Chemical treatments
Bunch Development at Spraying



Calcium Nitrate - 2.5kg per 100L



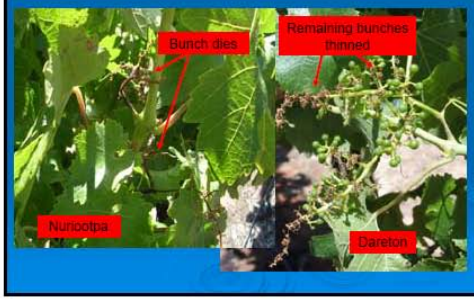
Calcium Nitrate - *Bunches @ 33 days*



Ethrel® @ 50 &100mls / 100L

- Applied at full bloom: 24th of Oct (NSW), 6th Nov (Nuri) & 17th Nov 06 (Loxton)
- First signs of result after 7 days
- Berry drop continued for 5-7 days
- At least 45% reduction of bunch numbers
- Reduced berry numbers in surviving bunches

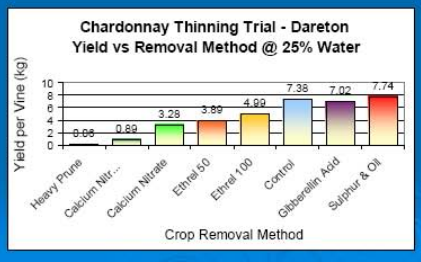
Ethrel® - *Typical Results*



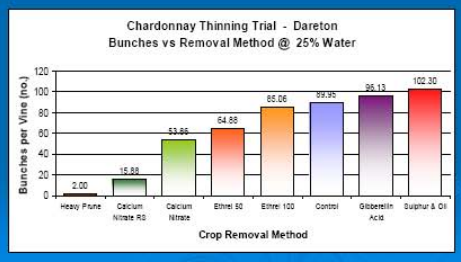
Gibberellic Acid – Dareton @ 50ppm



Dareton – Trials Results



Dareton – Trials Results



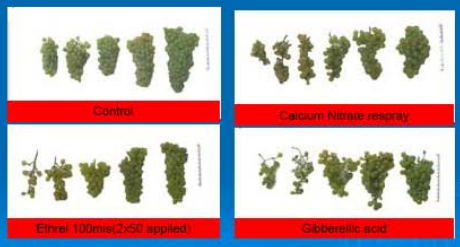
Harvest - Control vs Ethrel®



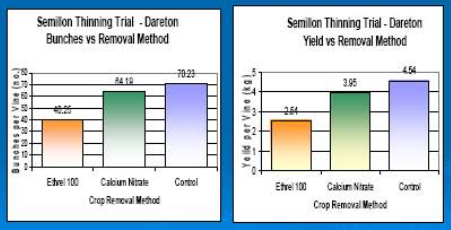
Bunches at harvest-Chardonnay & Semillon



Bunch Comparison at Harvest



Dareton – Trials Results



Stress Symptoms in Autumn



Best Crop Reduction Methods

1. Heavy winter pruning
2. Ethrel sprays – 100ml or 150ml/100L
3. Double application of calcium nitrate
4. Reduced water application combined with one of above

- More research needed to understand carryover effects on crop & growth

Costs of Pruning & Sprays

- Initial machine prune ha $ 280 / ha
- Hand prune est. cost ha $2400/ ha
- Ethrel Spray ($21/$32) $120/ ha**
- Calcium Nitrate $55-$150/ha
  - Commercial contract rates:-(Ethrel® @ $50 per ha calcium @$88 per ha)
  - **varies with available machinery)

Take Home Messages

- Ethrel ® at flowering: 100 – 150ml/100L @ 1000L/ha, provided excellent, cost-effective crop removal
- The 150ml rate also reduced shoot growth in S.A.
- Bud dissection results-Dareton vines indicate a reduced fruitfulness, with sprays of Ethrel ® or Gibberellic acid

Take Home Messages

- Area in better situation than in 2005.
  - Still time to plan & allocate water!!
  - No surplus crop, & have a home for fruit!!
- Heavy pruning, or chemical thinning does offer the means to reduce crop!!
  - Plan, retrain or remove areas
- Avoid selling water off!!
  - Use the experiences of 2006 in NSW to make decisions.
- Go away after today & plan your future management decisions.

Take Home Messages



1. Manual or chemical crop removal may improve the chances of vineyard survival.
2. Water use can be reduced on Some white varieties, if available.
3. Early decision needed!!
4. If a small water allocation is available, crop thinning may permit the allocation to be rationed or redirected to high value varieties or blocks at greatest risk

Thanks for the Support

- GWRDC – funding
- John Crocker - SARDI, Lenswood, S.A.
- SARDI Staff & NSW DPI Staff
- Michael McCarthy – SARDI
- Michael Treeby – CSRIO -Merbein
- Tim Smythe - RWGIDC
- April Winckel – Winckel & Associates Management Services
- Nicole Dimos-DPI Vic

Grape and Wine Research and Development Corporation

NSW DEPARTMENT OF PRIMARY INDUSTRIES

Murray Valley Winegrowers' Inc

RIVERLINK
Linking Horticultural Centres in Sunraysia - Riverland

NSW DPI

Crop Removal Trial 2006

Initial trial results

Presentation prepared for the Murray Darling Viticulture Technical Group meeting, Irymple DPI - 8TH November 2006

NSW DEPARTMENT OF PRIMARY INDUSTRIES

Treatments considered

- Calcium nitrate
- Gibberellic acid
- Ethrel®
- Zinc sulphate
- Sulphur plus oil
- Urea
- Potassium nitrate
- Heavy winter pruning

Treatments used

- Calcium nitrate
- Gibberellic acid
- Ethrel®
- Sulphur plus oil
- Heavy winter pruning

Other treatments- not used

- Ammonium thiosulphate*
- Regalis®*
- Mechanical thinning*
- Propane burner*
- Zinc chloride
- * being trialled by SARDI in South Australia

Measurement to be used

- Bunch no per vine
- Flowering data
- No. Death bunches per vine(7-10days)
- No bunches at harvest
- Bunch wt at harvest each treatment

Calcium nitrate-Spraying



Applied with hand wand



Aim ;Whole Bunch wet to runoff

Damage after 7-10 days





60-95% reduction in bunch numbers

Typical bunch damage



Large bunch-just before flowering

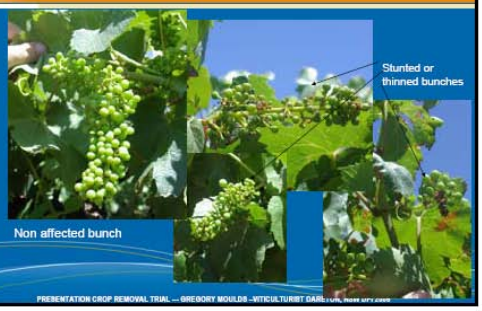


Damage to large flowering bunch



Small bunch before branching

Type of Bunches after 33 days



Other affect- growth retarded

- Foliage and bunch retarded
- 4 leaf stage-1 month delay in growth
- Spray at flowering 2-3weeks delay in growth
- Bunches smaller and stunted



Ethrel®-spraying

- Spraying applied 24th October
- After 7 days first signs of result
- Berry drop continues for 5-7 days
- 45% reduction of bunch nos
- Reduced berry per bunch

Ethrel®-spraying

- Applications on Chardonnay
  - Single application of 75mls /100L water
  - Two spray treatment used 75mls/100L and 14days later 100mls/100L
- Semillon
  - Applied single applications at 75mls and 100mls

Ethrel®-spraying typical damage



Sulphur and Oil



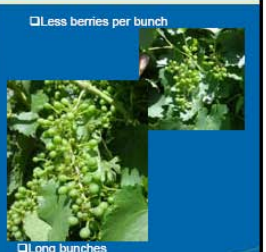
- Rate 600gms sulphur & 500mls oil
- No bunch thinning
- Minor leaf burn



Gibberellic acid



- Less berries per bunch



- Long bunches

Control bunches

Heavy pruning-before & after





Summary of observations



- Most arms have shoots
- Best growth on vines 1/2 water
- 40-50 shoots per vine
- 1-2 bunches per vine
- Very vigorous canes
- 1-2 canes broken due to wind
- One vine has no regrowth?

Heavy pruning-observations



Shoots growth-no pattern



Balling



Yellow speckle

Heavy pruning-managing regrowth



Costs of pruning

- Initial machine prune $280 ha
- Hand prune est. cost $2400 ha
- Regrowth $125 ha
- Optional
  - Slashing of pruning $250 ha

Summary results

TREATMENT	TIMING	REDUCE BUNCH NO	BUNCH THINNING	AFFECT ON VEGETATIVE	OTHER COMMENT
Heavy pruning	Dormant stage	yes		maximum	Cost, re- growth management
Calcium Nitrate	4 leaf stage	yes	yes	3-4 week	Variable results Blunted bunch
Ethrel®	Flowering &berry set	yes	yes	nil	May need a higher rate or 2 applications
Gibberellic acid	Flowering	no	yes	nil	Reduces Berries per bunch Bunch stretching
Sulphur & oil	Flowering &berry set	no	no	minimal	

Using on mothballed vines





Other implications

- Conduct further trials with Calcium nitrate, Ethrel ® & other chemicals
- Develop MRL and a use protocol for future
- Use of calcium nitrate and Ethrel ®
  - With reduce irrigation and nutrition
  - Integral part of management
- Proceed with registration Ethrel® in vines
  - Crop regulation as normal practice
  - Use with high yielding young vines

Thanks you -support

- John Crocker- SARDI-Lenswood
- Liz McGuire- Murray Valley Wine grapes
- Jeff Milne- DPI Victoria
- Michael Treeby- CSRIO-Merbein
- John Hawtin –ADFA
- Tim Smythe-Riverland wine

APPENDIX 7 – Mothballing Articles

1. Mothballing: A hot topic – Gregory Moulds (2006) NSW DPI Grapevine Management Guide.
2. Vineyard Mothballing – Gregory Moulds / Liz McGuire (2007) Riverlink Research Seminar handout.
3. Mothballing Update – Murray Valley Winegrowers' Grapevine
4. Survey Update – Murray Valley Winegrowers Grapevines

A range of other articles have arisen from the RITA "Mothballing the Vineyard" project and are not included in this report.

Mothballing: a hot topic

GREGORY MOULDS, DISTRICT HORTICULTURIST (VITICULTURE), NSW DPI, DARETON

As the industry across most production areas struggles with oversupply or no home for their grapes, many viticulturists are grappling with ways to stay viable and remain within the industry. One method that has been discussed is to mothball part, or all of, the vineyard.

Mothballing can be defined as:

> To maintain a non-producing vineyard with minimal but critical inputs to allow a rapid return to cropping for productive use or sale in the future, when the industry situation has improved.

The concept of leaving a vineyard in mothballs goes against all our beliefs, our training, and the reason why we do what we do—grow grapes! To take a dynamic, living, viable vineyard, turn off the tap and not apply inputs during a season is a challenge to the mind that is hard to accept and go through with. In general, most growers are reluctant to make such changes, or they feel that they do not have the experience or knowledge to commence or commit to mothballing.

The sight of your own dormant vines and much of the district with the grapes hanging on the vine is, in itself, depressing and often soul-destroying to the proud can-do viticulturist.

In the face of oversupply, most production areas and districts have begun projects or held annual viticultural meetings to provide answers to growers' questions, including the benchmarking of growers and districts, practical options for reducing costs, and alternative cultural practices.

The Murray Valley Winegrowers (Sunraysia NSW and Victoria) and the State departments of primary industries have obtained Regional Innovation and Technology Adoption (RiTA) funding to look at the concept of mothballing.

The components of the project were to:

- conduct a growers' meeting to guide the project
- hold a forum of growers, viticulturists, industry representatives, consultants, and research and extension viticulturists to discuss technical issues relevant to mothballing
- survey growers' levels of knowledge relating to mothballing
- conduct a baseline survey of grower practices and related needs
- develop demonstration field trials.

The first event was a joint regional meeting held in the Barossa and at Mildura. A checklist of questions was developed and distributed to all growers and industry representatives.

The checklist covered:

- financial management
- marketing fruit
- property planning
- pruning
- thinning
- irrigation
- nutrition
- pest and disease management
- alternative management.

The aim of the forum was to

- develop potential techniques for mothballing
- list the positives and negatives of each technique
- develop possible steps that can be taken when deciding to implement techniques
- determine the short-term and long-term implications of each technique with regard to vine health and fruit quality
- determine how long it would take a vineyard to return to production
- rank the most practical techniques for use in a vineyard.

The main techniques arising from the forum were

- chemical crop removal
- physical removal of fruit
  - harvest removal of fruit (berries at either pea-size or veraison)
  - fruit and canopy removal at fruit set

- minimal inputs
- severe winter pruning
- cutting cordons
  - cutting the top cordon off
  - cutting vines below the cordon
- irrigation stress at flowering
- zero input.

The planned field demonstration trials are to be located at the Agricultural Research and Advisory Station at Dareton, NSW. The trials will include eight rows of Chardonnay grapes planted on Ramsey rootstock. All rows will have eight thinning treatments applied on two occasions. These treatments will include calcium nitrate, zinc sulfate, Ethrel®, sulfur and oil, a heavy winter pruning, and a control. Four rows will have standard irrigation and fertiliser treatment. The remaining four rows will have half standard water and fertiliser applications.

It is the aim of the RITA project is to produce some practical guidelines on what, how, and when to mothball.

To date, there is no one treatment that will be useful in mothballing a vineyard. It is likely that a combination of changes will be required to be successful. Mothballing on its own will not be the magic bullet in solving the oversupply of grapes.

It is still unclear whether a winery will agree to take any, or all of, the grapes produced after a period of mothballing. What is clear is that careful planning, making informed decisions based on financial inputs, and having a plan with clear objectives are required.

Vineyard mothballing

Greg Moulds, Department of Primary Industries, Dareton
P 03 5019 8400 E gregory.moulds@dpi.nsw.gov.au

Liz McGuire, Murray Valley Winegrowers Inc, Mildura
P 03 5021 3911 E liz.mcguire@murrayvalleywinegrapes.com.au

Aim: To maintain a non-producing vineyard with minimum but critical inputs to allow a rapid return to cropping for productive use/sale in the future when the industry situation has improved.

Trial results

Calcium Nitrate



7-10 days after application

Typical bunch damage



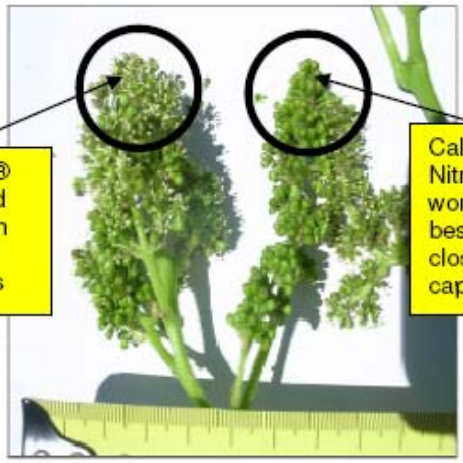


33 days after application

Ethrel

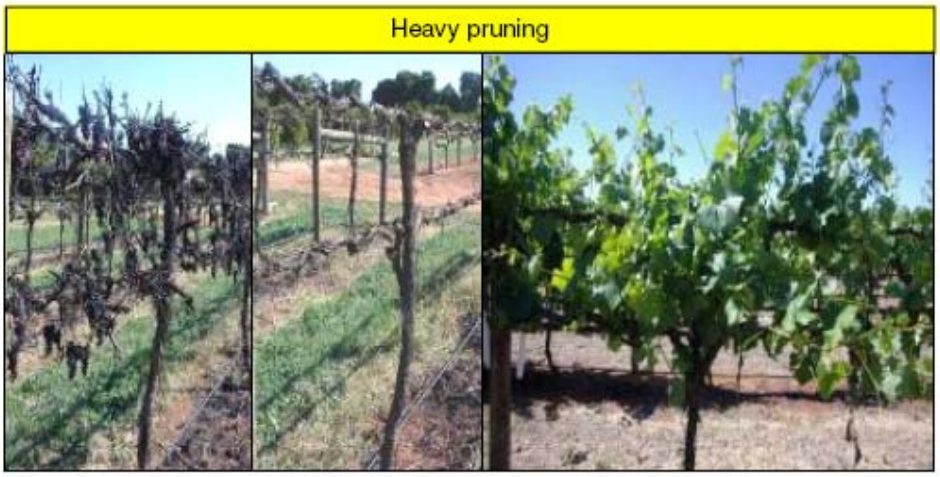


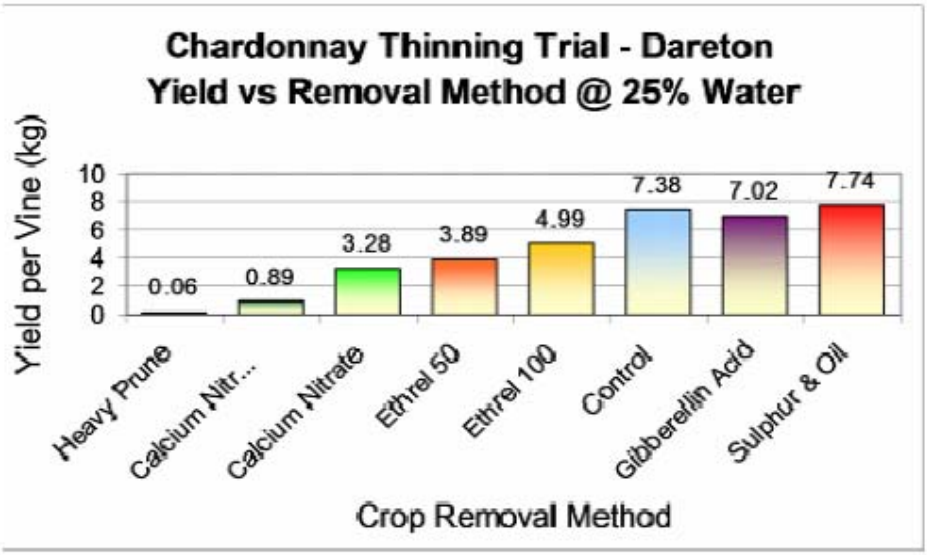
Typical spray damage



Ethrel® worked best on open flowers

Calcium Nitrate worked best on closed caps





Note: Treatments illustrated in this document are experimental and for demonstration purposes only. Ethrel is not registered for the removal of fruit in winegrapes. Use of the above treatments is at your own risk. No responsibility will be taken for any decisions and/or trials you may investigate within the boundaries of your property, based on the findings of this project.

Mothballing Trials

Update report

Greg Moulds
NSW DPI Viticulture Officer

As reported in the last edition of Murray Valley Winegrowers' Grapevine, some trials are underway to determine the effectiveness and impact on vine health of a number of mothballing treatments. Following is a visual account of some of the mothballing treatments that have been trialled as part of the mothballing project funded by the Grape and Wine Research and Development Corporation.

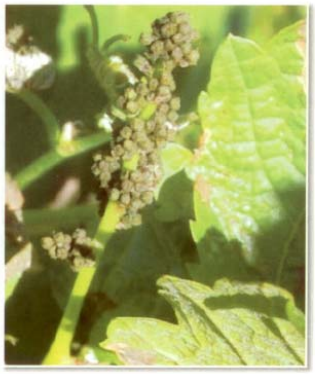
Calcium Nitrate

7-10 days after application




Calcium Nitrate

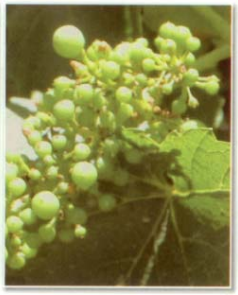
Typical Bunch damage


Mothballing Trials (cont...)

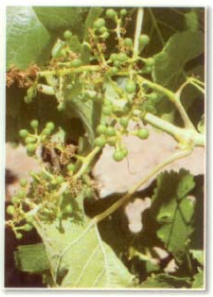
Calcium Nitrate

33 days after application

Ethrel

Typical spray damage

Heavy Pruning





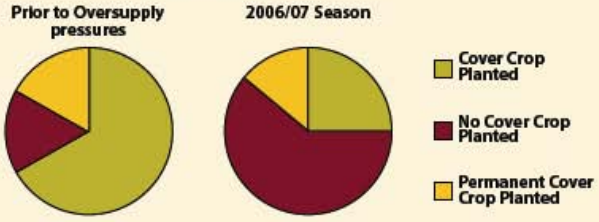
Benchmarking oversupply

Measuring the impacts

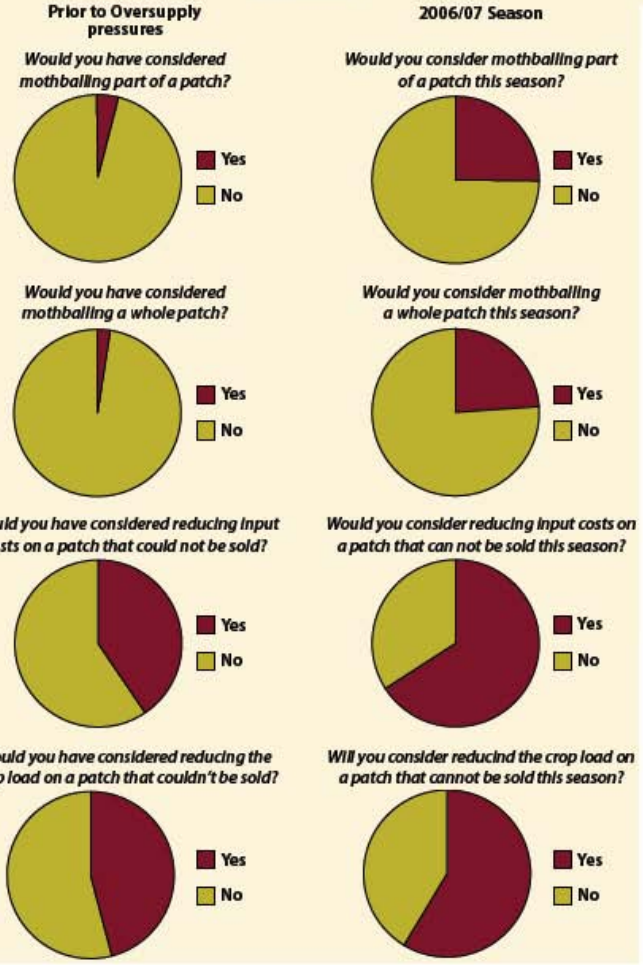
Liz McGuire
Industry Development Officer

The Australian winegrape industry can change dramatically between seasons. This is evident from the stark differences in yield between the 2005-06 and 2006-07 seasons. Last year there were more than 50,000 tonnes in the Murray Valley that couldn't be sold whereas this year it's highly unlikely that any will be homeless. About 400 growers assisted Murray Valley Winegrowers' in benchmarking changes in attitude that may have occurred as a result of the 2005-06 over supply. The assistance of these growers is very much appreciated. Below and in future editions of "Murray Valley Winegrowers' Grapevine" the results will appear. Have a look and see if they are what you expected? Remember, participants were also regarding the 2006/07 season as if over supply would continue.

Cover Crops



Mothballing



Growers database

Only half the story

Less than half the growers on the database of Murray Valley Winegrowers' returned the survey forms that were mailed last year, with a deadline for their return of December 22.

The database survey is conducted each year to give us an up-to-date picture of the state of our industry in terms of area planted to particular varieties, planting intensions, type of rootstock, type of irrigation and so on.

Thank you to the 544 growers who replied. (The Murray Valley Winegrowers' database contains almost 1300 names and addresses of growers in the Murray-Darling and Swan Hill wine regions. We use this database as a mailing list for this newsletter and other information).

Even though incomplete, the survey forms that were returned and collated reveal some interesting statistics, such as:

- 10,103 hectares are planted to 49 different varieties of wine grapes, 8,852 hectares bearing and 1,251 hectares non-bearing
- 6,055 hectares are planted to vines on rootstock, 3,420 hectares are known to be "own roots" while 627 hectares were not specified
- Drip irrigation is used to irrigate 4,895 hectares, overheads are responsible for 2,880 hectares, undervine for 1,577 hectares, with furrow irrigation the irrigation method for 547 hectares

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