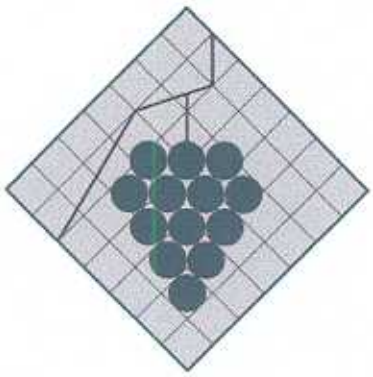


To undertake a feasibility study for collaborative research with other Australian Research Institutes to investigate the influences of vineyard applied nitrogenous fertilisers on soil chemistry, vine performance and juice and wine quality

FINAL REPORT to
GRAPE AND WINE RESEARCH & DEVELOPMENT CORPORATION

Project Number: **DAW 92/1**

Principal Investigator: **Mr B H Goldspink**

Research Organisation: **WA Department of Agriculture**

Date: **1992**

GRAPE & WINE RESEARCH &
DEVELOPMENT CORPORATION

FINAL REPORT

TO UNDERTAKE A FEASIBILITY STUDY FOR COLLABORATIVE RESEARCH WITH OTHER AUSTRALIAN RESEARCH INSTITUTES TO INVESTIGATE THE INFLUENCES OF VINEYARD APPLIED NITROGENOUS FERTILISERS ON SOIL CHEMISTRY, VINE PERFORMANCE & JUICE & WINE QUALITY

BY

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RESOURCE SCIENCE BRANCH

DIVISION OF PLANT INDUSTRIES

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GRAPE AND WINE RESEARCH AND DEVELOPMENT CORPORATION

FINAL REPORT

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Project supervisor	B.H. Goldspink Resource Science Branch Division of Plant Industries

During 1992, two visits were made to the Eastern States to discuss possible collaborative research programs involving various aspects of nitrogenous fertiliser use in the vineyard and its effects on grapevine performance, soil acidity and wine quality. Time was also spent during the 8th Wine Industry Technical Conference talking to research officers, vineyard managers and growers about attitudes towards nitrogen use in the vineyard.

Two GWRDC funded trips were undertaken between 26 April and 1 May 1992 (to South Australia and Victoria via Mildura) and between 9 and 10 July 1992 (to South Australia and Mildura). The first visit coincided with the GWRDC research and development meeting in Mildura. The second trip was timed to attend the ASVO seminar on irrigation in vineyards and also the AUSVIT irrigation module workshop (see attached reports). My thanks must go to everyone who helped in transporting me to the different venues as this enabled the two trips to be undertaken instead of just one.

It was apparent from my discussions that the major research into nitrogen use in vineyards in Australia is being carried out in Western Australia. There are four current nutrition trials in Western Australia, of which two are exclusively investigating affects of nitrogenous fertilisers on vine performance and wine quality. The other two are looking at interactions of N x K and N x P x K. All are on acid soils and three have vines on own roots. The fourth has vines grafted to Scharzmann rootstock. Wine is being made and assessed from three of these trials.

Where then is the potential for collaborative research most likely to occur?

1. Soil chemistry and leaching of nitrogen

The discussions held with Dr Peter Jerie and Mr Stuart McNabb at the Tatura Institute for Sustainable Agriculture, Victoria, held the most promise for a collaborative study to monitor changes to soil chemistry from leaching of vineyard applied nitrogenous fertiliser. Since our initial meeting in April contact has been maintained and a project will be submitted to GWRDC for funds to commence a trial in 1993 which will involve a practical program in Western Australia with intellectual support from Tatura in the first instance. As the project proceeds, and if funds become available in Victoria, practical programs may then run in parallel. This will draw on the initial results of the Western Australian work to further refine irrigation management as it effects leaching of nitrogen down the soil profile with subsequent changes to soil chemistry (pH in particular).

2. Plant chemistry

In discussions with the AUSVIT nutrition group, it became obvious that there was general concern with interpretation of the more widely use nitrate–nitrogen and total nitrogen petiole results. This occurs particularly when the vines are very vigorous yet have low nitrate–nitrogen, and or, total nitrogen test results indicating the need for application of nitrogenous fertilisers. There is also the problem of interpreting petiole analysis results from a sample taken at flowering if the majority of nitrogen is applied through the irrigation between fruit set and veraison and or post harvest.

Investigations into timing of sampling and type of tissue is currently underway in Western Australia. Collaborative research in this area may be possible with the Mildura group of Dr M. Treeby at CSIRO, Merbein and Dr S. Nagarjah at the Sunraysia Horticultural Centre. Dr Treeby has been working with Dr B. Taylor from Sunraysia on the interpretation of petiole nitrogen data for Sultana, as similar interpretation difficulties have been encountered with the dried fruit varieties. Unfortunately input into this research may be reduced with the recent early retirement of Dr Taylor. Dr Nagarjah will, I believe, be taking over some of Dr Taylor's duties.

There has been considerable interest in the Western Australian work shown by Mr P. Brockwell (Hunter Institute of Technology) in New South Wales. Mr Brockwell is currently undertaking some trial work with nitrogenous fertiliser rates in the lower Hunter River region, and may look at expanding the trials on the basis of the results which show a response to nitrogen. It would be necessary to visit both groups to review the work and look at further expansion into other tissues for analysis, and or further investigations into the use of amino acids as a more reliable indication of the nitrogen status of the grapevine.

3. Grape quality

There are two areas for possible collaborative research programs on grape quality.

(a) Grape secondary metabolites

This is a sub program of the CRC under the direction of Dr P. Williams at the Australian Wine Research Institute (AWRI) assessing grape quality at harvest. Dr Williams has agreed to carry out the analysis of fruit from the nutrition trials in Western Australia provided funding can be obtained from GWRDC. There is no doubt that vineyard applied nitrogenous fertiliser is influencing grape (and hence wine) quality. A test such as that developed by Dr Williams' team measuring grape secondary metabolites may be useful in assessing changes in grape quality to the extent that the necessity to carry out the more expensive exercise of small scale winemaking is reduced.

(b) PTA testing

Mr P. Iland has developed a test to measure the effect of skin colour in red (or black) grapes on wine style. The GWRDC funded sources of nitrogen trial with Cabernet Sauvignon has shown that increasing the rate of nitrogenous fertiliser to the vine will result in a colour density decrease in the wine. In a complex nutritional trial with Shiraz at Frankland, changes in skin colour and character were noted at harvest and wine colour density was reduced in the high nitrogen treatments. High potassium has been shown to increase colour density in wine in trial work in Western Australia with both Shiraz and Cabernet Sauvignon. Mr Iland has expressed an interest in working on trials in Western Australia, but future research would be dependant on funding from GWRDC.

4 Wine quality

Research in Western Australia has shown a direct link between nitrogen concentration in the juice and wine quality for Sauvignon blanc wines made using small scale winemaking techniques. Similar results were reported at the international symposium on nitrogen in grapes and wine at Seattle in 1991. This research has been discussed with Dr P. Henschke at AWRI and some collaborative work has been undertaken in the past with juice and wine analysis and wine tasting. In wine made from the Sauvignon blanc nitrogen trial, Dr Henschke found significant differences between some treatments. This was a similar result to that obtained in Western Australia by six accredited wine judges in a blind tasting. The quantity of wine made in each fermentation was less than three litres. At first Dr Henschke appeared happy to proceed with a collaborative study, then made a statement that the addition of nitrogen to the must in the winery was all that was required to maintain fermentation and improve wine quality. He then refused to carry out collaborative research unless a minimum of 25 litres of wine was made for each replicate of each treatment.

Both statements deserve some comment.

(a) Vineyard application versus winery additions of nitrogen

With the current trend towards low input viticulture, there is a tendency for growers to back off on application of fertiliser in the vineyard. Experience of this in Western Australia during the late 1970s and early 80s saw yields reduced to below economic levels, many problems with slow and stuck fermentations and H_2S formation during the fermentation. Nutrition trials showed the benefits of addition of nitrogenous fertiliser in the vineyard with increased yields and problem free fermentations.

In 1992, wine made from the Sauvignon blanc trial included an extra treatment. DAP was added to must from the nil treatment to compare with other treatments where vines received nitrogen at different times during the year. While the wines have yet to be placed before the judging panel, at bottling it was clear that the nil + DAP had improved flavour and aroma over the nil, however it did not rate as highly as some of the vineyard treatments. In 1993, DAP will be a standard addition for several trial wines made in the laboratory, at both high and low initial nitrogen concentrations in the must, to compare flavour effects. Wines will be analysed by GC/MS to determine chemical changes influenced by the DAP treatment.

(b) Wine volume

Dr Henschke has argued that without a minimum of 25 litres of wine, sufficient testing cannot be carried out to provide statistical significance which would be suitable for publication in an international journal. The wine volumes made in Western Australia are approximately 3 litres for whites and 7 litres for reds. While this does not allow for large scale organoleptic assessment, such as duo trio tasting, it is sufficient to carry out panel testings, such as those held at the Department of Agriculture in Western Australia and at AWRI on the Sauvignon blanc wines. Both groups have determined statistically that there was a significant difference between some treatments. Each treatment had three individually fermented replicates for assessment. During the tasting in Western Australia, the judges were also presented with duplicate wines for some treatments to determine the ability of the judge to reproduce scores. Common commercial wines of Sauvignon blanc were also presented to all judges to determine consistency between judges in scoring wines. If these internal testing procedures show consistency in judging, replicate wine scores show agreement and mean scores for treatments show significant differences, the argument for 10–25 litre fermentations and more intensive testing cannot necessarily be sustained. Agreement between replicates also indicates that the small scale winemaking techniques are excellent, which is always the major factor questioned in this type of debate over small fermentation volumes.

5. Wine chemistry

The Chemistry Centre of Western Australia has expressed an interest in setting up a collaborative program with AWRI to enable it to analyse wine using the same methodology as that currently in use at AWRI. It would be proposed that an officer from the Chemistry Centre visit AWRI to discuss methodology which would then be used to analyse wines made in the nutrition program in Western Australia. As part of the collaborative study, AWRI would be asked to help in the interpretation of the results. The work in Western Australia may well provide information useful to Dr Henschke's program on amino acid utilisation by yeasts, particularly in the low must nitrogen area.

The Chemistry Centre of Western Australia has the latest technology in GC, GC/MS and HPLC, along with other support equipment. Some modifications to the instrumentation may be required to carry out the wine analyses for which partial funding may be requested from GWRDC. Sample exchange between laboratories would ensure that results were in agreement. This would mean that another laboratory in Australia would be equipped to carry out wine analysis for research and industry, if required, as back up to AWRI.

From 1989 to 1990, a collaborative program with AWRI was set up to investigate the amino acid composition in free run juice and wines from trials where rates of nitrogen as fertilisers had been applied. Sample numbers were too large for AWRI to handle efficiently and, as a result, the HPLC in the viticulture laboratory of the Department of Agriculture Western Australia was upgraded to carry on with this work. The proposed upgrade of the facilities at the Chemistry Centre is also seen as an extension to this program as part of the ongoing research into the effect of vineyard applied nitrogen on grape and wine quality.

Summary

The technical conference in Melbourne provided some lively debates on the nitrogen issue. There was a lot of interest shown in the poster papers of our work which has resulted in requests for further information. While there were those who thought that the rates of nitrogen recommended for Western Australia were too high, there was an equal number who are currently using those rates and agree that there are benefits to be obtained both in the field and winery for some varieties.

There will always be controversy on the use of nitrogenous fertilisers in the vineyard. For every argument placed in support of its use there will be an ever increasing argument on environmental grounds against it. It is therefore essential that any future research work associated with nitrogen use in the vineyard must look at the environmental impact versus quality improvements in both vine performance (yield and grape quality) and wine quality.

The number of research personnel working on nutrition of grapevines in Australia is decreasing rapidly. Collaborative programs are not that easy to set up and the distance between Western Australia and eastern states centres provides problems. In Western Australia, we have shown that we are able to get responses to vineyard applications of N, P and K fertilisers to vines often seen as low or deficient by current petiole analysis techniques. We are also able to measure those responses in juice nutrients and changes in wine quality.

I would like to see more active communication between working groups (such as nutrition, soil acidity etc.) to discuss programs and problems such as the workshop held – Adelaide by the GWRDC – September 1990. In his summary of the workshop to Council the chairman made the following comment.

'Delegates agreed the workshop was most valuable. A future meeting (say ½–1 days duration) possibly linked with the 1992 Australian Wine Industry Technical Conferences, would be worthwhile. Unlike the clonal selection and rootstock evaluation group who have the CSIRO Vine Improvement Research Committee to update research, the grape vine nutrition group have no other formal opportunity to meet.'

This need for a GWRDC sponsored meeting was also seen at the R & D meeting held in Mildura on 29 April 1992 and again at the Mildura workshop – 9 July 1992, (see Appendix 1 and 2). There were many areas that required discussion and insufficient time to address them. A group meeting of approximately two days every two years would enable research programs to be presented and discussed. Industry involvement at vineyard manager level could be encouraged and priorities suggested for future GWRDC funding of projects. Collaborative programming could be discussed at these meetings and proposals submitted to GWRDC where organisations felt that they had the resources and time to contribute most to relevant projects. Currently there is insufficient communication made more difficult when so few are scattered so far with so little in funds to maintain programs.

I thank the GWRDC for their encouragement and support for this project and will continue to maintain the contacts that were made during my visits to the Eastern States.

APPENDIX 1

A preliminary report on Collaborative Research Project possibilities in the Wine Grape Industry

During a visit to Western Australia in January 1992, Mr J. McWilliam, Chairman of the Grape and Wine Research and Development Corporation (GWRDC) expressed enthusiasm for the winegrape nitrogen program currently being investigated by officers of the Department of Agriculture. The GWRDC has encouraged collaboration between research centres and it was thought that Western Australia could link in with projects at the Australian Wine Research Institute (AWRI) in Adelaide and the Victorian Department of Food and Agriculture Research Centre at Tatura. As part of a feasibility study into these collaborative programs, GWRDC funded a week of visits to research centres in South Australia and Victoria which was undertaken between 26 April and 1 May 1992. This also included the R & D meeting for the Corporation in Mildura on Wednesday 29 April.

1. Australian Wine Research Institute

(a) Dr Paul Henschke. Influence of juice nitrogen compounds on fermentation and wine quality

The research program in Western Australia has already had considerable support from Dr Henschke and other research officers at AWRI. Previous amino acid analyses were undertaken at AWRI on juice and wine samples from the nutrition trials. Wine had also been sent to AWRI for sensory evaluation following some good responses found during tastings in Western Australia. Significant differences were found in wine quality which could be attributed to the timing of nitrogenous fertiliser applications to the vines. Unfortunately, the volume of wine made was less than five litres, which Dr Henschke felt did not allow for tasting techniques required to give statistical analyses acceptable in international journals. To make the twenty-five litres of wine which Dr Henschke requires for such an analyses will require considerable re-evaluation of procedures in the small scale winery at the Department. This may influence later decisions on whether such a collaborative program can proceed and will become the subject of the full feasibility proposal for GWRDC later in 1992.

The nitrogen nutrition trials in Western Australia have shown that amino acid concentrations in the juice (and wine quality) can be influenced by fertiliser application. The CRC subprogram 1.3 strategic aim is to use genetic engineering to change the properties of wine yeasts to better use the available amino acids and enhance flavour release into the wine, particularly in grape musts of low nitrogen content. Until this can be achieved, wine makers rely on additions of DAP to the must or use vineyard applied nitrogen to increase must nitrogen to overcome stuck ferments and/or production of hydrogen sulphide in the wine. It is important the Department continues with this area of research, even with small scale wines of less then 25 litres, as other analytical techniques are being developed (apart from sensory) to evaluate chemical compounds produced during fermentation. These may then be related to fertiliser treatments. Collaborative research of this nature is already being undertaken with a postgraduate student at Curtin University.

(b) Dr Pat Williams. Grape secondary metabolites

The wine grape nutrition program in Western Australia can have a direct input into the CRC subprogram (in assessing grape quality at harvest), proposed by Dr Williams. Nitrogen responses have been obtained in current trials with Sauvignon Blanc, Cabernet Sauvignon and Shiraz. Potassium responses are being investigated in Cabernet Sauvignon and Shiraz, while phosphorus responses can be seen in the Shiraz trial.

Changes in the nutritional status of the vine can have marked changes in crop load, canopy size, the ripening period and juice quality for wine making. Flavour peaks during the ripening phase often to be earlier than when the desired sugar level is reached for wine making, particularly in cool years. These flavour changes may well be detected using the methodology proposed by Dr Williams. A collaborative study was discussed and funds will be requested from GWRDC to carry out analyses of fruit from the nutrition trials.

2. Dr Jeff Ladd. CSIRO Division of Soils. Soil Chemistry and use of N–15

Discussions were held with Dr Ladd about the possible use of N–15 labelled fertiliser to follow the nitrogen through the soil and vines throughout the growing season. Soil chemistry results, obtained from the nutrition trials, indicate that the major input of nitrogen is from the fertiliser (low soil nitrogen – low organic matter), which makes N–15 work easier to interpret. Collection of soil and plant material would be made during the growth cycle followed by a total destruction of the vine and removal of surrounding soil to ascertain the deficit of N–15 in the system at the end of the season. There is a possibility that the South Australian CSIRO could help with N–15 analyses at a suggested cost of around $10 per sample. Discussion could be held with Western Australian CSIRO about access to similar instrumentation in Perth.

The N–15 isotope has been successfully used in pot trials in South Africa with grape vines. It is proposed that discussions be held with Professor Alan Robson at the University of Western Australia and to offer this project as a possible postgraduate study for 1993/94.

3. GWRDC R & D meeting

Comments made during the meeting in Mildura indicated strongly that research officers should meet on a more regular basis in workshops to discuss current research and industry related problems. The formal and informal discussions that take place often give clarity to research and may help short cut many problems which arise during the research. It was apparent from the workshop group on irrigation, nutrition and soils that the hour allocation was insufficient to discuss work priorities in this area.

The work presented by Mr Ian Ballantyne and Dr Chris Green was valuable and indicates that more material of this nature could be circulated in interim reports which are more detailed than the GWRDC annual report. It would appear that final reports often get lost in the system or never see publication and hence the data is unavailable to the rest of the R & D group. We are all guilty of this.

4. CRC viticulture AUSVIT computer program

The AUSVIT computer program, being developed by Dr Brian Coombe's group, has considerable merit in clarifying interpretation of tissue analysis results and fertiliser application rates based on tissue nutrient monitoring in the vineyard. I appreciated the opportunity of attending the meeting on Monday 27 April and contributing to the discussion. I also appreciate being able to contribute further in the development of the package with interpretations based on the extensive nutrition program currently in progress in Western Australia.

I am sure that there are many areas in other aspects of the CRC proposal that officers of the Department of Agriculture Western Australia can contribute in a similar fashion. This applies particularly to Program 2 on low input viticulture under Dr Chris Green. While it is almost impossible for officers from Western Australia to attend meetings in Eastern States centres under the current funds situation, there is an opportunity for the committees to use some groups to externally review the work of the committees, and assess the practicality of using, and/or changing, program to include local variations that may exist. There is a possibility that GWRDC funds will be sought to allow officers from Western Australia to attend meetings or workshops to ascertain how inputs into such programs can be better coordinated. In the area of vine diseases it would also enable officers to see first–hand diseases that are not currently applicable to Western Australia and plan strategies for eradication of these diseases should they enter this state.

5. Visit to Tatura Institute for sustainable agriculture, Victoria

The visit to Tatura proved to be too short in time to fully discuss the work programs in place investigating the soil acidity problems associated with the use of nitrogenous fertiliser under drip and micro jet irrigation. Experiments being carried out by Mr Stuart McNabb, Dr Peter Jerie and Mr John Whiting with stone fruit and grapevines are similar in nature to those commenced in Western Australia during 1991–92.

The discussion group at the Mildura GWRDC meeting confirmed the soil acidity issue as being of major importance for future research. As part of the feasibility study of the nitrogen story, it would be important to consider a collaborative program not only with Tatura, but with other institutions in other states with similar acid soils. As this situation arises with fruit trees as well as grape vines (and vegetables) other funding bodies may become involved. The same technology applies in trying to retain the nitrogen in the top profile of the rootzone where it not only remains accessible to the plant, but where also remedial action on the acidifying effects of the fertiliser may be accomplished with comparative ease. A meeting of research personnel could take place in June or July at Tatura to outline a program to submit to funding bodies later in the year. A proposal to discuss this at a workshop on irrigation in Mildura on 9 July has considerable merit.

6. Visit to Victorian Chemistry Centre – sap nitrate measuring meters

Mr Peter Hansen has been using sap nitrate measurements to determine the nitrogen status of plants. Measurements can either be carried out using colour indicator strips or by specific ion meters. Preliminary investigations in Western Australia during 1991–92 showed that the meters were drifting and results unreliable. This problem had not been encountered by Mr Hansen with other plants, which suggested that meters may have been faulty or that there is a problem with the specific ion electrode measuring nitrate in grape petiole sap. Both Mr Hansen and myself will further investigate procedures, if time permits, during 1992–93.

The assistance of the GWRDC in funding this trip is greatly appreciated. The feasibility study will continue, on the basis of discussions held during the week, before a proposal is submitted for an extension of the existing nitrogen program in November 1992.

B.H. Goldspink
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14 May 1992

APPENDIX 2

Report on the Mildura GWRDC Workshops on the AUSVIT Irrigation Module and Nitrogen/Soil pH/Irrigation Interactions and the ASVO Seminar on Irrigation in Vineyards. 9 and 10 July 1992.

Nitrogen/soil pH/irrigation workshop — Convenor B. Goldspink

Attendance:	Mr Peter Jerie	Tatura Institute for Sustainable Agriculture, Victoria
	Mr Ben Robinson	Scholefield Horticultural Services, Adelaide
	Mr Brian Taylor	Sunraysia Horticultural Centre, Mildura
	Mr Phil Sinclair	New South Wales Department of Agriculture, Griffith
	Ms Lisa McFadyen	Agricultural Research and Advisory Station, Dareton, New South Wales
	Mr Phil Nicholas	Department of Agriculture, Laxton, South Australia

This workshop was initiated by me to allow discussion on the effect of nitrogen fertiliser on soil pH in the vineyard as influenced by method of application. From some of my own work and comments made during the GWRDCs R & D workshop at Mildura on 29 April 1992, the subject requires much further investigation. Work has already been undertaken at Tutura to measure the movement of nitrogen through the soil and in application of lime sources to try to correct subsoil acidity resulting from the application of nitrogen.

The purpose of the workshop was to review past work on acidification of vineyard soils and to propose future directions in monitoring current trials and or collaborative research programs.

Unfortunately the workshop start was delayed due to a late departure from Adelaide of Ben Robinson and myself. Mr Peter Jerie was able to discuss his work with those present, however, the whole group had less than one hour to look at other work. Some discussion centred on why there was a poor neutralising effect down the soil profile even when a large amount of lime was placed under the dripper. Ben Robinson proposed that there could be an interaction between water quality and its ability to leach hydroxide ions from the lime.

I was able to present some results obtained from trials in Western Australia and also report on a project being undertaken by an honours student from the University of Western Australia. Soil pH profiles are being determined away from the source of nitrogen application and rates of lime sources are being applied to the soil to investigate the neutralising effect of the lime with depth.

Some participants expressed concern at the changes in soil pH and the problem associated with reversal of the process. The general feeling was that more soil sampling was required to determine the extent of the problem.

At this point the workshop was closed to allow the AUSVIT irrigation workshop to commence.

AUSVIT Irrigation Module Workshop — Convenor Dr Brian Freeman

Attendance: Approximately 50 including growers, Industry Representatives and R & D officers from State and Federal organisations.

The AUSVIT computer program is described as an Australian viticultural management expert system which has, at the moment, four modules being developed (see attached outlines). These are diseases, insects, chemical use and nutrition. The purpose of the workshop was to outline the proposal for a fifth module on irrigation and to look at the nutrition module as an example of the value of the package to industry.

In a brief introduction, Dr Freeman commented on the large amount of fund money being spent on irrigation research in Australia. In 1990 the Dried Fruits Cooperation allocated $110,018 to six projects out of a budget of $303,175. Between 1989 to 1991, GWRDC allocated $169,318 to several specific irrigation projects from a budget of $1,297,318. Other projects listed by GWRDC had irrigation as a component in the research title. This meant that resources around Australia on irrigation techniques for grapevines were quite significant when unfunded projects were also taken into account.

An expert system was defined as a computer system designed to stimulate the decision making of a human expert. The AUSVIT package was designed around a similar package used by the Penn. State University and other organisations in the United States of America to give growers and advisers quick answers to on farm problems. The projected stages for the AUSVIT package were:

1. final prototype 1993;
2 grower evaluation and revision 1993–95;
3. commercial release 1995.

After a demonstration of the nutrition module, growers present appeared encourage by the potential of the system. Further discussion became bogged down on the principle of intellectual property of the research personnel and organisations contributing information required to get the program up and running. There was also the legal responsibility behind any recommendations made in the package based on the data input by growers or advisers. The package was seen by Dr Freeman as being part of the CRC Viticulture program to which Director Generals of State Departments of Agriculture had pledged their organisational support. Input time and other financial aspects may have to be negotiated between the organisations. GWRDC had allocated $30,000 to the program. Experience with the nutrition module had shown that a considerable number of man hours were required in setting up the hard copy of information followed by the computer programming required to bring this together in an easily accessible format.

The following ideas in the irrigation module were put forward during a brief brainstorming session.

1. User Growers/Managers

2. Goals Education – site specific information – growers start questioning their own vineyard dynamics:
   - efficiency of water use
   - profitability (yield quality etc.)
   - sustainability (resource management)
   - disease interactions
   - nutrient interactions
   - diagnosis (problems, systems)
   - site specifics (state variations)
   - soil management.

3. Modules objectives
   - scheduling (vine requirement – water availability)
   - efficiency of system
   - root system dynamics (where and density)
   - soil management
   - water quality
   - crop end users
   - sensors
   - flexibility (time and availability of water)
   - canopy transpiration rate
   - crop development and/or variety
   - other management limitations
   - manipulation of plant growth.

The workshop concluded without a clearly defined program, but with a general agreement to proceed with the modules already in progress and for Dr Freeman to negotiate with organisations interested in contributing to the irrigation module.

ASVO Irrigation Seminar

There were approximately 230 in attendance. The numbers indicate the industry interest in irrigation technology and in new directions in sustainability of water resources.

Dr Brian Freeman: Vineyard Irrigation in Australia: Research practices in vine response – history and potential.

There had been a concept that irrigation resulted in poor wine quality. It did result in yield increases, delay in maturity and reduced sugar, but effectively managed it, reduced the variability between seasons. Changes occurred in the 1960s to 1970s with the introduction of new grape varieties and with new irrigation techniques.

In calculating the crops' water requirements it was necessary to use:

1. meteorological data; class A pan and the Penman–Monteith equation;
2. agricultural data – root density and depth, canopy information and soil type and depth.

In trials at Griffiths using flood irrigation it was found that 60% of the water applied was lost through evaporation. Wide rows used more water than narrow rows due to a higher evaporation rate. At Charles Stuart, tensiometers were used, one in the middle of the root zone at 25 cm and the other at 50 cm. Irrigation was started when the top tensiometer was at 25 millibars minimum. This was continued to fruit set. Between fruit set and veraison the vines were stressed by allowing the lower tensiometer to reach 25 millibars before applying water. After veraison the top tensiometer was again used to indicate water requirements.

A critical factor in all irrigation procedures was a system which was efficient in delivery and detectors which were placed in the correct positions to measure the soil moisture in relation to the root system.

Mr Peter Jerie: Regulated deficit irrigation (RDI) of grape vines: from concept to practice.

Irrigation practices must be sustainable and profitable. There must be a strategy before developing a scheduling system. The strategy should include:

(a) the quantity and quality of water;
(b) possible effects of salt and fertiliser leaching (e.g. nitrogen leaching, soil acidity and ground water pollution);
(c) site variability and management requirement to cater for this.

In the past growers have irrigated to keep plants free from stress. However, it has been found that this does not necessarily provide the best result. RDI can be used to regulate the growth rate of the plant but still allows for adequate fruit growth. Water use may be as high as 50% more in the rapid fruit growth stage.

With grapes this is the period from veraison to harvest. Water stress in this period was not found to improve sugar levels in the fruit. Water stress between budburst and fruit set was found to decrease berry numbers. By comparison stress between fruit set and veraison was found to set more berries but these were smaller than the control of no stress. RDI was found to have some influence and juice pH and TA.

Some moisture measuring devices were found to be suspect in different soil types and at increasing soil water tension. Using the neutron probe and a class A pan evaperimeter were found to be the most reliable.

Mr Mike McCarthy: RDI of grapevines and its commercial implications.

Studies in the mid 1980s showed that much of the irrigation water applied was moving into the water table and/or draining off into the river systems taking salt and nutrients with it. Experiments showed that increasing irrigation from 20% class A pan to 40% does not increase yield provided there are sufficient buds on the vine. Vineyard productivity is relative to what the vines use and not to what is applied.

Australian wine exports have increased dramatically from 10 million litres in 1983–84 to 60 million litres in 1991. To sustain this increase, quality must be maintained or improved. Correct irrigation techniques can help to do this. Some results from a GWRDC funded irrigation trial were presented, however, as they were only from the first year, few conclusions could be drawn from them.

Other speakers

There were seven other speakers during the seminar presenting results from industry and research organisations. The message from all speakers was that growers have to become more responsible in their attitude to water use by:

(1) becoming more familiar with the vineyard site;
(2) better monitoring of soil moisture;
(3) developing RID strategies;
(4) closer monitoring of sprinkler outputs and efficiencies;
(5) understanding and adopting new regulations on water use and drainage.

The attendance at the seminar, the questions asked of the speakers and the discussion that took place during the lunch and tea breaks indicated that growers were becoming more aware of their responsibilities with water use. I would strongly recommend that a similar seminar be held for local growers which could include some of the speakers from this seminar.

I look forward to the proceedings of the seminar.

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DIVISION OF PLANT INDUSTRIES