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Organic grapes and wine: a guide to production

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The tastebuds, health concerns and environmental conscience of affluent consumers are demanding more organically grown food than producers worldwide can supply. Growing consumer concerns about the effects of synthetic chemical pesticides and fertilisers on human health and the environment have boosted world trade in organic products by a rate of about 20-30 per cent a year for the past 10 years. World trade was estimated to be worth $US 21.6 billion in 2000 and is expected to reach US$100 billion by the year 2006.

The Australian market for organic products alone is valued at $200-$250 million - with exports estimated at $30-50 million - and is growing at around 20 per cent annually. Organically grown grapes, dried fruit, organic wine and even vinegar made from organic grapes are part of the growing markets in Australia and overseas.

Australian organic wine is well placed to take advantage of the high regard overseas markets place on conventional Australian wines. Australian organic wine producers can also ride on the back of the local horticulture industry, which has a good reputation overseas as a ‘clean, green’ supplier. But it is important to note that, like the conventional wine market, a premium is paid only for top quality wine. The organic label alone is not enough.

From a practical perspective, Australia is well suited to organic viticulture. Disease is relatively easy to control because many of Australia’s viticulture districts are in areas of dry climate. Australia is also blessed with the absence of some diseases and pests that hamper grape production in other countries.

The phenomenal rate of growth in the organic food industry and the premium prices it offers have provided the financial opportunity required by an increasing number of growers to make the ‘great leap’ to organic production. Those to have converted include several big Australian wine companies, which either have their own organic brands or are testing organic systems on parts of their vineyards.

Greater production of organic food in the world has also been fuelled by growing concerns among producers about the long-term environmental impact of conventional farming. For example, excessive or uninformed use of pesticides and some chemical fertilisers has led to:

- insect, weed and disease resistance.
- damage to natural predators of pests.
- loss of structure and health of soils due to indiscriminate destruction of productive soil-borne flora and fauna, which range from beneficial microbes and fungi to earthworms.

Worldwide growth in the production of organic food has had many spin-offs. One of them has been the sharper focus on the success of organic farming practices, which has inspired greater confidence in alternative farming methods. In doing so, it has also diminished to some extent the psychological dependence on synthetic chemicals to beat weeds and pests.

With a sound knowledge of organic production and good forward planning, vignerons have made a success of organic grape production in most wine growing areas of Australia. Forward planning is essential to avoid major frustrations and wastage of time, money and effort. When considering setting up an organic vineyard system special attention should be paid to:

- Location - environmental factors of a site can affect disease, insect and weed control.
- Producing premium wine - ensures good returns at reasonable prices. Selection of variety is a major factor.
- The type of trellis and pruning management - ensures excellent sun penetration and air flow, which are important for disease control.
- Disease management - can be managed adequately by a small range of products and supported by a holistic management system.
- Nutrient management - based on cover crops, composted and naturally occurring material.
- Good hygiene and minimal exposure or contact in winemaking - especially important for organic wines.

Organic production to date has created a large pool of practical knowledge, which has provided the foundation of this booklet. Based upon information provided by experienced Australian organic and biodynamic producers, this manual aims to provide conventional grape producers and aspiring vignerons with enough information to assess the feasibility of creating an organic system.

Yields from organic vineyards can be as high as those from conventional systems but are generally lower, ranging from 3 tonne/hectare to 18 tonne/hectare depending on age, location, production system and variety. Lower yields than conventional systems are expected from organic systems as the focus is on quality rather than quantity.
Two of the chief guides for organic production are certification and quality assurance.

A Government accredited certification system, based on The National Standards for Organic and Biodynamic Produce, ensures that a product for export labelled ‘organic’ is genuine. Certified food can be marketed as organic using a government-accredited certifier logo. Using this logo on labelling allows the consumer to make a distinction between genuine organic articles and products labelled with unsubstantiated claims of organic production methods. The government-accredited certifier logo not only provides confidence in the integrity of the produce for the consumer, but also protects the supplier’s niche market against unwarranted claims of “organic”.

To achieve certification status, growers are required to demonstrate they understand the organic system, comply with the regulations and are regularly inspected. They must prove they have established organic production practices. These include the use of crop rotations and crop residues, animal manures, legumes, green manures, mechanical cultivation and approved mineral bearing rock dust to maintain soil productivity and supply plant nutrients. Biological management and manipulation is used for the control of insects and weeds.

While the Australian National Standards were designed to certify produce for export, reputable local retailers are now demanding produce offered as organic on the domestic market be certified according to the same strict guidelines.

This booklet provides general information on how to achieve organic certification status from several perspectives:

- Converting a conventional vineyard.
- Planning a new vineyard for future conversion to an organic system - conventional practices would be used for early establishment.
- Using organic principles from the very beginning.

Quality assurance ensures the appearance and texture of organic produce is in line with consumer expectation, which is largely influenced by conventional produce available to them. However consumers expect the taste of organic produce to exceed conventional levels. Consumer research has shown they expect a higher level of sweetness and flavour from organic product - perceptions often based on childhood experience of product picked from their own gardens.

Quality wine is essential for repeat business.
All agricultural producers aiming to supply overseas organic markets must legally certify their production systems through a government-regulated process to prove the ‘organic authenticity’ of their produce. Food legally authenticated as ‘organic’ can be labelled with a brand of proof - a crucial marketing strategy that wins consumer confidence and consequently attracts price premiums.

While organic product for export is well regulated, there is a great need in the domestic Australian market place for legal distinction between genuine organic produce and conventional food labelled with the words ‘organic’ or ‘biodynamic’. This allows consumer confidence in such claims and supports international competitiveness. It can also help set true organic and biodynamic produce apart from other commodities that have been created slightly away from conventional methods - for example, using low amounts of chemical. Appropriate labelling also extends to use of the words ‘biological’ or ‘ecological’. You only have to walk through a supermarket to see conventional produce labels using the words ‘organic’, ‘biodynamic’, ‘biological’ or ‘ecological’ without proof or substantiation, attempting to project the perception of the ‘clean and green’ image of genuine organic food.

Certification

Distinction, and therefore certification, is necessary for both production and processing of food. For example, a certifiable distinction is made between genuine organic produce and conventional food labelled with the words ‘organic’ or ‘biodynamic’. This allows consumer confidence in such claims and supports international competitiveness. It can also help set true organic and biodynamic produce apart from other commodities that have been created slightly away from conventional methods - for example, using low amounts of chemical. Appropriate labelling also extends to use of the words ‘biological’ or ‘ecological’. You only have to walk through a supermarket to see conventional produce labels using the words ‘organic’, ‘biodynamic’, ‘biological’ or ‘ecological’ without proof or substantiation, attempting to project the perception of the ‘clean and green’ image of genuine organic food.

However, in many cases winemakers do not take that last step, preferring to market their wine without organic certification. This wine is often described as ‘made from organically grown grapes’. More winemakers are taking this approach because organic winemaking is a more expensive process. Some also want to avoid a limited (historical) market perception that organic wine is inferior in quality.

Many overseas markets not only consider certification as essential but also place great value on the reputation and recognition of a country’s organic certification system. The Australian Quarantine Inspection Service (AQIS), a Federal Government agency, in conjunction with the Organic Industry has provided Australian organic growers with a well regulated system for organic and biodynamic produce that has gained a good international reputation. Australia’s solid worldwide reputation as a supplier of authentic organic produce had led to it being one of the very few countries pre-approved by the European Union for importation of organic food.

Organic certification, via an AQIS accredited certifier, is granted to growers and processors who follow the minimum legal requirements for production of export goods labelled as ‘organic’ or ‘biodynamic’. These minimum requirements are outlined in the ‘National Standards for Organic and Biodynamic Produce’, administered by the AQIS. Copies of the national standards are available through the certifying organisations, Australian Government Bookshops and the AQIS web site (see reference list for details).

The ‘National Standards for Organic and Biodynamic Produce’ provides organic farmers with a sound definition of organic agriculture as follows:

“Organic farming systems rely to the maximum extent feasible upon crop rotations, crop residues, animal manures, legumes, green manures, mechanical cultivation, approved mineral bearing rocks and aspects of biological pest control to maintain soil productivity and tilth, to supply plant nutrients and to control insects, weeds and other pests.”

Certified vineyards are subject to regular and unannounced inspections by organic certifiers, accredited by AQIS, to verify that an organic system is in place and operating in compliance with Federal Government requirements. Inspections ensure comprehensive record keeping systems are in place to allow trace back and verify inputs used, management, yield and sales.

Contact details of the seven AQIS-accredited certifiers are provided in Appendix 1. These certifiers are usually grower-supported bodies. Not all are involved in certifying grape production or winemaking and each, generally, has its own standards for organic production that at least match the minimum mandatory government requirements. Their additional standards are based upon different approaches to organic production (see Appendix 3 for examples) so you will need to discuss your needs with them to determine which certifier is most appropriate for you.

Full certification as ‘organic’ for growers may be granted after a minimum of three years in full compliance with standards. It may take considerably longer to meet the extra standards laid down by some certifying bodies.
During the initial years of transition toward full organic status on an established vineyard, yields will, as a general rule, drop and the price premium associated with fully certified organic produce may not be available to compensate. However, growers may realise higher prices than conventional produce in as little as one year by gaining what is know as ‘organic in conversion’ certification. This allows access to a market looking for a “grown without chemicals” product. Another financial solution is ‘part certification’, which allows part of a property to be converted to an organic system while the remainder is farmed by conventional methods. This can spread the costs over a longer period.

While organic food for export must be legally certified, the same standards are not required by law for the domestic market. However, reputable local retailers are now demanding certified produce from their suppliers to the point where it is expected certification will become a voluntary, market-driven process.

**How to achieve certification**

**Grape production**

Organic certification of farming systems generally takes three or more years to achieve. During the first year of compliance no organic certification is granted. In the second year of compliance, certification as ‘organic in conversion’ may be granted. Progress to full ‘organic’ status will take a minimum of three years complying with standards.

Once you have decided to commit to production of grapes using certified organic methods, you will follow a general sequence of steps:

1. **Choose an organic certifier**
   Interested growers or processors should contact the AQIS accredited certification organisations (Appendix 1) to discuss the following:
   - The criteria for organic or biodynamic certification.
   - Your certification needs.
   - Export market destination requirements.
   - Costs associated with certification.
   - Procedure and timing before certification can be granted.
   - Obtaining a copy of the organic farming or processing standards to which your farming or processing system must comply.
   Each certifying organisation has slightly differing requirements, although all comply with the minimum AQIS national standards.

2. **Understand organic standards**
   Growers must demonstrate a good understanding of organic farming principles and knowledge of practices and inputs permitted as well as those prohibited under the certifier’s organic standards.

3. **Modify the production system**
   Changes to the production system must be implemented where conversion is required. Whether converting an established vineyard or creating a new organic vineyard, the grower must prove that an appropriate system is in place and successfully operates in compliance with the organic standards.

4. **Apply for certification**
   Once organic standards have been applied in the farming system, application for organic certification of the system can be submitted. Upon receipt of an application the organic certifier organisation will issue a farm questionnaire seeking all relevant details describing the farming system. Information sought in the questionnaire typically includes land use history, rotations, inputs used, details of farming practices and a map of the property and surrounding land use. The questionnaire forms a Statutory Declaration relating to farm practices and inputs used.

5. **Undergo farm inspection**
   A site inspection by an experienced organic farm inspector will follow soon after the questionnaire has been returned to the certification organisation. The purpose of the site inspection is to verify the details of the farming system as described in the questionnaire and to ensure the grower has a good understanding of the principles and methods of organic farming.
   
   Apart from discussing the farming system, the inspector will view paddocks, crops and livestock as well as equipment, sheds and storage areas. The grower must also provide complete documentation of all inputs used, output produced and sales details for all organic products. This documentation will then be audited. Soil samples or tissue samples may also be taken for testing.

6. **Receive a farm inspection report**
   Following the farm inspection the inspector compiles a report confirming details of the farming system that has been established. This report, together with other relevant documents, is considered by the certifier to determine the appropriate level of organic certification. Specific conditions may be imposed where certain practices or circumstances require attention.
7. **Enter an organic certification contract**

The certifier then offers the grower a contract stating the land and crops to which the certification applies and any conditions that must be met. Acceptance of the contact and payment of fees allows the grower to market relevant product labelled as certified ‘in conversion’ or ‘organic’ and bearing the logo of the certifier.

**Conversion periods**
- Obtaining the right to use the words “organic in conversion” on labelling will take at least 12 months from application for certification.
- To obtain a certificate enabling use of the word “organic” in labelling will generally take a minimum of 3 years.
- These times can be reduced in special circumstances where the grower can provide solid documented evidence their production system complies with the certifiers’ standards.

Organic certification contracts are generally subject to annual inspection of the site and farm records. The grower is required to complete a statutory declaration confirming compliance with the standards and detailing yields and sales figures for the year.

Growers may also be subject to unannounced and random on-site inspection as part of the obligations certifiers must fulfill to satisfy AQIS accreditation. In addition, some properties may be subject to inspection by AQIS representatives as part of the regulation of the certifying bodies.

**Winemaking**

There are two possible approaches to making wine from organic grapes.

Firstly, organically certified grapes can be processed into wine using conventional means but with a minimum of chemicals and additives. Wine made from this process is labelled ‘made from organically grown grapes’, not as ‘organic wine’. Currently, this is the most common alternative as it is relatively easy to do in a conventional winery.

The second alternative is creating true ‘organic wine’. This is done with organically certified grapes in accordance with a code of organic winemaking practice endorsed by the certifier and meeting the National Standard. Some conventional winery practices may have to be modified in order to comply with these standards.

For example, the Organic Vignerons’ Association of Australia has eight requirements for certification of wine as ‘organic’ as follows:

1. **Annual Statutory Declaration**: A declaration must be completed for each batch of wine by the winemaker when seeking approval to use the term ‘organic’. The declaration relates to grape supplier details such as name, certification number, production methods and details of accreditation.

2. **Wine processing agreement**: The winemaker and bottler agree to comply with procedures and practices required for organic wine (see winemaking section).

3. **Delivery declaration**: This provides the winemaker and bottler with proof that the grapes or wine delivered were sourced from an organically certified vineyard/winery.

4. **Winery inspection check list**: A qualified person, usually a professional winemaker, inspects the winery to ensure that the approved practices are being followed.

5. **Certification checklist and approval form**: This ensures that the winemaker’s statutory declaration has been cross-checked to the vineyard and that the grapes have been grown according to organic principles.

6. **Certificate of compliance**: Certifies that the wine has been made in accordance with organic production regulations (see wine making section).

7. **Two bottles of finished, labelled wine from each certified batch must be submitted to the certifying body. One bottle may be tested for residues and the other stored for reference.**

8. **Penalties for breaches of the standards are similar to those applied to grape growers. For winemakers, if the breach is accidental, accreditation for the batch of wine is revoked and stocks must be withdrawn from sale until claims of organic certification are removed. If the winemaker’s breach is intentional, membership is revoked for two years and any certified wine must be removed from sale until claims of certification are removed.**
Growing organic grapes

The Options
The Procedural Manual of the Organic Vignerons Association of Australia states that when applied to grape growing and winemaking the term ‘organic’ refers to:

“The production of grapes of high quality, with an emphasis on nurturing and maintaining the land for future generations without the use of synthetic chemicals...

...There is an emphasis on the use of renewable resources, clonal and rootstock selection, pest control through integrated pest management techniques, the need for conservation of energy, soil and water resources and the maintenance of environmental quality, with the utmost restrictions on external inputs, especially fertilisers and chemicals. The production cycle is as closed as possible.”

In an organic viticulture system vines are considered as part of a complete ecosystem, with emphasis on the following*:

• Quality rather than maximum yield.
• Maintenance of an ecologically diverse environment which includes plants, fungi, microorganisms and animals.
• Caring for the soil using sod and cover crops, mowing and mulching. No herbicides are used and many weed species are regarded as useful for nutrient cycling and supporting a diversity of soil activity.
• Preventing pest and disease problems using biological management, and pruning and training systems to improve canopy aeration. In emergency situations insecticides and fungicides with the least impact may be applied.
• Careful planning of vineyards to reduce potential problems. This involves choice of site, rootstock, variety and training system.
• The reduction of pollution by avoiding synthetic chemicals.
• The strengthening of vines using various herbal preparations.


Optimal yield of quality organic grapes

An aspiring organic grape grower has three avenues for producing an organic vineyard:

• Convert an existing conventional vineyard;
• Establish a new vineyard using conventional techniques and convert to organic later; or
• Create a vineyard using only organic techniques.

Each has its advantages and disadvantages but the most common and relatively simple method is to convert an existing conventional vineyard to organic. Not only would the infrastructure have been set up, but most of the start-up difficulties (particularly insect control) would have been overcome, the vines would be mature and existing soil nutrient levels would most likely be adequate.

In the initial stage of conversion, the grower simply switches to practices that improve soil biological activity and reduce chemical usage. It is also possible to have a parallel production system where part of the vineyard is converted to organic while conventional techniques are used in the rest of the vineyard.

Conversion from well established vines has its disadvantages. Well established vines undergoing conversion are likely to be near conventional vines, posing the threat of contamination from spray drift. Also, conventional trellis systems may not be the best for organic grape production.

While unacceptable levels of residue in the soil from past applications of fertiliser (such as cadmium) and chemical sprays may be a problem, many vineyards have been managed over a long period of time with minimum use of chemical inputs. The prospective organic vigneron will need to have soils tested for residues before making a decision to convert.

Creation of a new vineyard using only organic or biodynamic methods is the best alternative for those growers chiefly concerned about the impact of synthetic chemicals on their farm environment. It is also the certifier’s choice because it shows the grower’s commitment to organic principles. However, it can be the most difficult, time-consuming and expensive of the three options chiefly because of vine establishment - weed and insect control and nutrient provision are much harder under organic principles.

Greater risks and higher costs are involved in controlling insects if chemical insecticides cannot be used, although some organic materials are claimed to give adequate pest control. Use of guinea fowl or chickens are recognised ways of controlling some insects but they can damage vines in the first year or two.
Approved organic fertilisers do not provide nutrient elements as quickly as those in highly soluble form, such as chemical fertilisers. Organic principles require approved fertilisers to directly feed the soil - not the plant - to improve the soil's biological activity and increase its organic matter. The improved soil, in turn, provides nutrients in a slow release fashion to the plant. Fertigation with acceptable substances can be used but not as a routine practice.

**Marketing**
Plan your vineyard project to include an outlet for the grapes or wine. If you do not plan to include a winery on the property, make sure you secure a market for the grapes. Such markets may mean a contract with local winemaking facilities. If available, an advance contract may be desirable.

An established organic winery within easy reach of the vineyard would be a major advantage, ensuring almost certain sales for high quality, certified organic grapes.

Where the vineyard plan includes a winery, the marketing plan for selling the wine needs to be focused on obtaining maximum value.

A West Germany study indicates that direct marketing is the only way to get the full premium for quality and organic wine.
Site selection

At a glance - Things to consider

- type of wine to be produced
- the grape varieties preferred
- grape growing conditions - climate
- availability of good quality water
- proximity of wineries and/or tourist roads
- isolation from sources of contamination
- disease, pest and weed burdens
- amount of sunlight
- suitability of soil
- air drainage

The success of organic farming lies to a large extent in planning. The many future benefits of pre-planning organic production cannot be promoted enough - your yields are more likely to be closer to their potential in a shorter time and at less cost. Of all the planning you are required to undertake, that which relates to the site of your vineyard is of the greatest importance to the outcome of your organic venture.

While weeds, pests and diseases are more difficult to control in an organic system, their control can be minimised significantly by selection of a suitable location. Initially, this means choosing a district which has minor pest and disease status while the site itself should have low weed infestation.

The most suitable sites for organic grape production tend to be irrigated, low vigour sites in dry climates with medium fertility, because they favour good control of vegetative vine growth. Excessive vine growth can lead to shading of bunches and the creation of an environment (humid and warm) favouring disease.

Vigor on deep soils may be controlled with irrigation on sites where there is no summer rain. However, vigour control on deep, fertile soils may be difficult if they have a high water holding capacity. If excess vigour is likely to be a problem, duplex soils with a relatively shallow root zone may be recommended. Old vineyard districts in high rainfall areas are best avoided.

On the subject of soils, it is best to find out as much as possible about the suitability of a property's soil types for vines. This involves soil testing, soil mapping and determining soil depth.

The chosen site should have good ‘air drainage’, with enough breeze from prevailing winds to keep vines well ventilated and so reduce fungal growth and germination of fungal spores. The floor in a small valley may not have adequate air movement.

Vineyard layout for good air flow

Sunlight is important not only to produce sugar for ripening berries but also to ensure good drying conditions around bunches for control of disease. Morning sunlight can be important so, where possible, vine rows should be aligned in a north-south direction for maximum bunch exposure. On sloping sites, advantage should be made of the contours where possible.

The most suitable climate for grape growing is warm and relatively dry during the growing season, with low humidity when grapes are ripening.

A degree of isolation from other vineyards is an advantage as contamination may occur from chemicals used on adjacent properties. A buffer zone of at least 10 metres must exist between non-organic and organic producing vines. Pesticide residues from earlier use of the land are more likely if the district is prone to fungus diseases and/or insect and weed infestations. Old vineyard districts in high rainfall areas are best avoided.

If possible, the fertiliser history and nutrient status of the soil should be known, as well as previous pesticide use. The soil should also be submitted to chemical and pesticide analysis. High pesticide or heavy metal residues may prevent organic certification. More importantly, soil testing will determine if adequate nutrients are available and give the grower a reference point for long-term monitoring.

Availability of good quality water for irrigation may also be important when choosing a site - not just for plant growth but also regulation of plant growth and, therefore, disease. Ensure the property has a bore or pumping license or a dam if you are intending to irrigate your vines.
Other factors to consider include decisions that conventional vigneron have to make:

- **Type of wine to be produced**
- **Topography and shape of block**: A block to be used for vines should not be too steep. If the vines are to be pruned and harvested mechanically, the shape of the block must accommodate long rows to allow economical operations.
- **Proximity of wineries and/or tourist roads**: Consider the proximity of crushing and winemaking facilities when choosing the location of the vineyard. If you are intending to sell part of the wine vintage via cellar door sales, a tourist town or road should be nearby.

It is recommended, where possible, to draw upon local knowledge and experience to help with basic decision-making.
Starting a new vineyard

Planning for future conversion
The most effective and cost-efficient way to start an organic vineyard is to create an infrastructure suited to organic production but use conventional establishment methods and convert to organic in the future. Under this system, the grower is able to avoid problems with viable establishment which can lead to extra replanting and training costs.

Apart from chemical inputs, specific establishment requirements are similar to those of a non-organic vineyard - mainly site selection, varieties, trellis design, irrigation, nutrient management, pruning and harvesting.

Limited use of fertilisers, herbicides and insecticides can provide the vineyard with a good, cost-effective start without leaving residues that could preclude organic certification. For example:
- The most effective way of reducing weed competition and ensuring survival of young vines is to treat planting lines with a non-residual knockdown herbicide before planting.
- Relatively ‘soft’ insecticides can be used to control pests such as garden weevil and various caterpillars.
- Materials acceptable to organic systems are available to control diseases likely to affect young vines.
- Fertilisers such as superphosphate and calcium nitrate can help early establishment as they are more readily available sources of nutrients for young vines. Tissue and soil testing should ensure that excessive rates of application would not be used.

Superphosphate should be considered generally for Australian soils, which have low native phosphorous concentrations, and where even high rates of rock phosphate will be inadequate to support good vine establishment. Calcium nitrate is least damaging of the commonly available nitrogen sources and can be applied at regular intervals through the irrigation system during the first summer.

Growers’ Notes
Case study 1 - establishment system
- Spread gypsum, grape marc and chicken manure as needed before ripping (South African technique).
- Cross rip north/south and east/west shattering to 600mm,
- Offset disc plough used to chop soil blocks brought up.
- Planting lines are line-ripped down row using winged tine 30cm wing at 15-degree angle. Gets to 900-1200mm.
- Posts, drip system installed.
- Roundup used in early stages.
- Grapes planted in September,
- In third year can harvest good yields and go into conversion phase.
- Top soil moved from inter-row to under vine row - vine grows better when top soil deeper.
- If the vine gets a good start in early growth, it retains growth rate over greater number of years.

Starting by organic or biodynamic principles
Establishment of vines for organic production will involve:
- Preparing the soil for planting, including nutrient management
- Designing the vineyard layout and choosing a trellis structure for optimum management of water, light and air flow.
- Laying down an irrigation system.
- Choosing planting stock.

Soil preparation for planting
Soil preparation should start in the year before planting vines. The ground should be fertilised and good weed control ensured - which may include establishment of a cover crop.

Preplanting nutrient management may include applying rockphosphate/guano or compost to cover crops. Biodynamic growers will use various biodynamic preparations in developing their soil.

Cultivation is used for initial weed control. Soils prepared for vine planting areusually deep-ripped in two directions to remove debris and break up hardpans. This applies to both conventional and organic situations.

It is recommended to rip along the planting lines and provide deep placement of phosphorus fertiliser. High rates of superfosphate are applied in this way in conventional situations but this is not acceptable for organic vineyards. Superphosphate could be replaced by untreated rock phosphate for an organic vineyard but rock phosphate takes much longer to release phosphorus in an available form to plants, especially in alkaline soils.

Lime is required to raise the pH of acid soils in many grape-growing districts. It is usually topdressed at high rates. It is acceptable in organic vineyards to use untreated lime from a natural source.

Compost and mulch may be concentrated around the young vines - not only as a fertiliser but also to conserve moisture. Care must be taken as nitrogen availability to the vines may be
affected with the breakdown of the compost. Side delivery systems have been used for large-scale operations.

**Vineyard layout and trellis design**

Organic principles encourage the planting of vines on the contour to improve infiltration and avoid run-off and erosion. The layout should also be designed to maximise air drainage and light availability in the canopy. Close planting of vines should be avoided if it is likely to lead to greater shading and reduced air movement through the vines.

The trellis type is critical as it will possibly have the greatest influence on air movement and availability of light. An open system such as the Lyre trellis (or Smart-Dyson) is favoured in most situations, although it is costly to erect. The lyre system can not be harvested mechanically.

The various vertical-positioning systems can also be effective and are usually suited to organic systems where vigour tends to be lower than in similar conventional vineyards. However, in high vigour sites, shading of basal buds in vertical positioning may reduce fruit set for the following year, leading to a cycle of decreasing fruitfulness.

District practice and experience is often the best guide because the importance of light penetration varies from district to district. Trellis design is less significant in hot, dry climates than in cooler, higher rainfall areas where vigorous growth accompanied by high humidity may encourage fungus diseases.

Training the vines to suit the chosen trellis system is identical to that in conventional vineyards and usually begins in the second year of growth. High rates of fertiliser and irrigation may necessitate earlier attention in conventional establishments but this would be rare in an organic situation where vigour is often lower.

An essential reference is “Sunlight into Wine”, by Richard Smart and Mike Robinson.

**Spacing**

Vine spacing may be varied according to climate, expected vigor, soil type, variety and available equipment. The vigour, the site and different varieties may also influence spacing. For example, it should be closer - but without crowding - for low vigour. However, there are no standards when it comes to spacing - some are as low as 1500 vines per hectare while others can be as high as 3000 plants per hectare.

*Open trellis design allows for good air movement*
Irrigation

Irrigation design is an essential part of vineyard layout and generally involves installation of a trickle system by the time the rootlings or cuttings are planted. Irrigation is generally essential for rapid establishment and early growth. A suitable trickle system can also be used for fertigation.

The irrigation system is commonly used to apply nitrogen from synthetic fertilisers, often in the form of urea. This is not acceptable in organic vineyards, but organically derived substances such as fish emulsion may be used.

Water use must be regulated to avoid waste of water, leaching of nutrients and possible increases in salinity of the groundwater or raising of the water-table. A soil moisture monitoring system should be installed so that the future irrigation regime will provide for the vines’ minimum needs on each soil type in the vineyard.

Growers’ notes

Case study - black plastic for weed control

Cape Mentelle Vineyards is developing an organic vineyard at Witchcliffe, WA, using black plastic for weed control along the vine rows. The vineyard manager made the following points on irrigation of his organic system at a seminar in Margaret River:

- Irrigation for white grapes is different to red.
- Drip tape will be laid out under the plastic. Once the plastic deteriorates, the remainder will be removed and micro sprinklers installed, not drippers.
- Drip irrigation is not the best irrigation method in vineyards - just look at the influence of natural rainfall on vine growth. Watering and vine feeding over the whole vineyard floor will be much more effective.
- The micro sprinklers should also help in establishing early winter cover crop growth and to ensure that our spring/summer cover crops flower.

Planting stock

Premium varieties are favoured because quality is paramount in organic grapes and wine - the extra effort of operating an organic vineyard should not be wasted on lesser varieties.

Varieties and clones should be selected for superior disease or insect resistance or tolerance as well as likely demand for each variety when the time comes to market the grapes.

Vines on rootstocks that regulate vigour and resist disease or insect attack are favoured for organic growing because this reduces the need for later control measures. Use of resistant rootstocks is particularly important if there is any risk of phylloxera being introduced.

Planting stock should be free of diseases such as downy and powdery mildew, crown gall and phomopsis and not harbour mites or other pests. These are likely to be difficult to eliminate or control at a later stage. The ‘virus status’ of the planting stock should be known.

Planting material for new organic vineyards or for re-establishing in existing organic vineyards should be quality stock from the Vine Improvement Association and must come from organic nursery sources unless otherwise approved by the certifying organisation.

The insect/disease susceptibility and the quality characteristics of premium varieties within each district are well known. Established growers or experts should be consulted. Generally, varieties or clones with open bunches and smaller berries are less susceptible to disease than those with large berries in tight bunches.
Development and maintenance of healthy soil is essential in organic vineyards because there is little scope to use fertilisers for rapid correction of nutrient deficiency. This requires much more attention and closer monitoring than conventional systems.

Soil and nutrient management, the basis of organic viticulture, focuses on improving the soil over a longer term by increasing organic matter, biological activity, water retention and aeration using natural inputs and minimum cultivation.

Fertilisers
Under an organic system, nutrients, in the form of organic matter, rock phosphate, fish emulsion and other allowable forms are fed to the soil so it can be broken down by microbial soil activity and made available to the plant in a slow-release form.

Most organic farmers rely on green manure or leguminous cover crops and fertigation products such as fish emulsion to supply nitrogen. They are encouraged to use compost made from material harvested on the property as a major source of nutrients and organic matter. Ground natural rock powder may be used as a source of phosphorus, potassium, magnesium and trace elements.

The ‘National Standard for Organic and Biodynamic Produce’ requires that enough organic material be returned to the soil to maintain or increase the soil’s humus content. Recycling of nutrients is major feature of any organic farming system. The certified organic property must operate within a closed system as far as possible, with inputs from outside sources kept to a minimum and used only where no other alternative is available. There may be limits placed on the amount of manure or compost that can be brought in.

Allowable nutrient inputs include; compost, fish by-products, rock phosphate, wood ash, gypsum, lime and various forms of seaweed.

Biological material added to the soil should generally be composted by natural means. Composting is essential for animal manure and materials brought onto the property from non-certified sources. Mulching materials applied to the soil surface do not have to be composted but their use must be documented.

Cover crops
Cover crops and in some cases a permanent sod provide a cheap and effective means of building up the soil organic matter and soil structure, encouraging the development of soil microorganisms and earthworms. Cover crops can serve a range of functions. These include:
- Reduced soil erosion.
- Suppression of weed growth through ‘smothering’ of unwanted plants.
- Provision of soil nitrogen where legumes make up a large proportion of the cover.
- Maintenance of beneficial organisms which provide nutrients to the vine by breaking down mineral and organic matter.
- Development and maintenance of good soil structure, leading to further benefits such as improved trafficability.
- Breaking up of sub-surface hardpans where deep-rooted plants are included in the crop.
- Attraction of beneficial birds and insects, especially if the crop is allowed to flower.
- The possibility of suppression of nematodes or other unwanted organisms through the use of selected species.

Selection of species sown in a cover crop will depend on the main requirements of the vineyard and the soil and water available.

In most organic vineyards provision of soil nitrogen is a priority and legumes are sown to ‘fix’ nitrogen from the atmosphere. Where nematodes are a problem, brassica crops such as radish may be sown as possible soil ‘fumigants’. They also have strong taproots that can penetrate hardpans.
Grass species may be preferred in areas where light brown apple moth is a problem because some broad-leaved species favour this pest. The strong fibrous root system of grass species is good for soil structure.

Different species are sometimes grown in alternate rows and rotated to provide the required benefits. Species may also be sown as a mixture, especially in permanent swards. Availability of irrigated water may influence the choice of species because cover crops growing into summer may reduce moisture available to the vines. In some situations this can be an advantage if it is necessary to reduce vigour in the vines to avoid excessive vegetative growth. Annual species that set seed early and die off in summer may be favoured where competition with the vines for moisture must be avoided.

Whatever species is selected, it should be resistant to or tolerant of insect pests. Spraying a cover crop for pest control is not an option.

Regular mowing of the cover crop (or permanent sward) may be desirable to maintain species composition and density, to provide organic matter to the soil and to reduce moisture uptake. The crop may be slashed, with the cut material thrown under the vines as mulch to suppress weeds and reduce moisture evaporation.

Fertiliser for cover crops in organic vineyards must meet the requirements of the ‘National Standard for Organic and Biodynamic Produce’ (see Appendix 2).

An excellent general guide to cover crop selection and management is “Cover crops - A Guide to Species Selection and Sward Management”, published by the South Australian Seedgrowers Co-operative (SEEDCO) and the Grape and Wine Research and Development Corporation. For more information or to acquire a copy, contact SEEDCO.

**Making compost**

Compost is a friable dark brown product that has a characteristic earthy smell. The term compost tends to be used to describe several products that may or may not be composted, but it should only be used where the product has been through a controlled process of microbiological degradation. Simply leaving a heap of material in a corner for weeks or months does not constitute composting.

Composts suitable for soil incorporation are usually fine in texture. The coarser grades of compost, often those made from green waste or other woody materials, are more suitable for applying to the soil surface in a layer (i.e. use as mulch) and may provide additional benefits to mulch, which has not been composted.

It is essential to soil test before you make compost to ensure you use the right ingredients and rates. Compost analysis is essential as the composition will likely have an effect on the soil and vine. Compost with a low nitrogen content, for example, may result in poor fruit quality. This strategy can save time, money and heartache in the long run.

Compost can be made in a number of ways - from relatively simple and low-cost mechanically-turned windrows to more capital-intense in vessel systems. Regardless of the process, composting requires materials to be uniformly mixed, moisture content maintained in the range of 50 - 60 per cent, adequate oxygen levels and temperatures between 50 to 70ºC in the centre of the pile.

Most well made compost is about 50 per cent moisture, which allows for maximum biological activity. Australian compost standards require compost to have moisture contents above 30 per cent.

A wide range of ingredients can be used to make compost. Carbon is provided by materials such as straw, green waste (tree and garden prunings), paper and wood. Nitrogen is usually provided by local animal manure, as well as vegetable and food wastes. These are blended to produce a carbon to nitrogen ratio of between 20 and 40 to one.

Organic growers are using any available approved input for making compost including grape marc, pig manure, chicken farm waste, cattle feedlot manure, saw dust and orange waste.

Organic growers have used rock phosphate (as a phosphorus source) and brown coal dust (as a carbon source) in composted form as a nutrient source. These too should be added according to concentrations indicated by soil tests.

Organic growers regularly apply trace elements as required by soil tests. These include copper, zinc and manganese - mostly as the sulphates - which can be mixed into the compost.
Growers on some light river soils in Victoria apply mixtures of compost and grey flood plain clay to improve soil water holding capacity.

Grape marc is seen as a good potassium source.

They have also used other products to promote biological activity. Some of these consist of blends of fish emulsion, protein, bacteria and fungi which generally require brewing up before application. Several organic viticulturists have indicated they have seen benefits from this material.

In some cases compost may be supplemented by certifier approved proprietary products such as ‘Complete Organic Fertiliser’, fish emulsions, rock dust, dried blood, bone meal and the equivalents. Some of the blood/bone products have been applied to other horticultural crops to get quick responses when deficiency of nitrogen has been detected - rates of up to 150 or 200 kg/ha have been used.

Some growers use parts of the property to grow material for compost production and run animals on the property to complete the nutrient cycles. This is generally in line with the intent of the organic certification requirements.

Lime, where required, can be safely mixed with the compost before application, saving on spreading costs.

**Compost quality**

While some producers make their own compost from locally sourced inputs, others buy in commercially produced compost. There is an Australian standard (AS 4454-1997) designed to ensure compost is not contaminated or harmful to plant growth. The standard, however, is voluntary and does not aim to make statements concerning the product’s contribution to plant growth.

Some growers should ask the supplier for evidence of their compost complying with the Australian standard. Organic growers must also ensure the compost is approved for use by their organic certifier. Growers should also feel free to ask for additional information such as:

- the compost's ingredients
- the nutrient (nitrogen, phosphorus and potassium) content of the compost. Special note must made of the fact that compost is not a replacement for fertiliser and does have other benefits, as stated earlier.

**Compost application**

Once established, compost and mulch may be concentrated around young vines. For example, one small grower spread composted chicken litter at about 2-3 shovels over 0.5 metre by a metre to encourage root spread.

For large-scale operations, side delivery systems have been used. Applications are made 50cm either side of the vine row. However, compost is also often used to fertilise the cover crops, in which case it is broadcast in the area between the vines and incorporated at seeding or top dressed after establishment of the cover crop.

Compost should be applied as a mulch to vines every three to five years or depending on the rate of breakdown. Mulches applied 30-50 mm thick around the base of vine crops will help to conserve soil moisture and reduce soil temperature and weed growth, thus contributing to improved crop growth and yield. Research in South Australia has demonstrated that these improvements are significantly greater if the mulch is composted.

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<td>Complete organic fertiliser</td>
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</table>

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*Example prices of organic matter (1998)*

Large scale commercial compost production

Growers on some light river soils in Victoria apply mixtures of compost and grey flood plain clay to improve soil water holding capacity.

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More information about compost
There are numerous sources of written information about composting - the Internet, consultants working with compost products and manufacturing technologies, and compost manufacturers. Be on the lookout for bias and seek information from more than one source. Use other growers to cross reference information sources.

Growers’ notes
Case study - nutrient input program
- Applied compost around young vines at one tonne/hectare and inter-row for three-year-old vines at eight tonne/hectare.
- Applied commercial rockdust at recommended rates. Local basalt dust used at higher rates.
- Dolomite used for pH management.
- Rock phosphate applied pre-establishment and in three to five year rotation, after five years soils change.
- Blood and bone applied to young vines at a rate of 500 g/vine to help promote growth. Do not apply when mature. Rate needs to be adjusted if blood content of locally supplied blood and bone changes.
- Locally made fish fertiliser applied through drip and as foliar spray.
- Seaweed applied (as for fish fertiliser) for disease control.
- Earthworm castings applied.
Monitoring is an essential aspect of vine management in any vineyard - but it is doubly important for organic growers. Regular and detailed monitoring of the vines is paramount in maintaining vine health and gaining early warning of potential pest or disease attack.

Control of weeds, pests and diseases is more complex in organic than in conventional vineyards because synthetic pesticides are not available to organic growers. Defence requires an integrated approach, most importantly the production of strong and healthy vines.

**Weed control**

As herbicides cannot be used in organic vineyards, weed control depends mainly on cultural means. This may involve:

- **Cultivation:** Limited cultivation controls weeds in many situations. However, frequent working of the soil is not acceptable because it destroys soil structure, burns up organic matter and destroys earthworms and other soil dwellers. A cutting blade that severs weeds just below the soil surface is sometimes used for control under vines.

- **Smothering:** Weed development can be cut short by blocking off their access to sunlight. This can be done a number of ways:
  
  a) **Cover crops:** Weeds can be smothered by growing a dense and vigorous cover crop. This is an effective approach where climate and soils allow suitable cover crops to be grown. Cover crops must not be grown if they will unduly deplete moisture needed by the vines.
  
  b) **Mulch:** Application of straw mulch along the vine rows may also be used to smother weeds. The origin of the straw and its weed and chemical residues should be checked.
  
  c) **‘Weedmat’ or black plastic strips:** These can be used along the vine rows to prevent germination or smother germinated weeds.
  
  d) **Mowing or slashing:** Weed growth between the vines can be kept in check through mowing or slashing. Slashed material from cover crops or other growth may be propelled from mid-row to smother weed growth near the vines.

- **Thermal control:** This requires a flame or hot water. It is expensive and not generally successful.

**Growers’ Notes**

**Weed programs**

**Case 1. Adelaide Hills.**

- Weeds were difficult to control. Hot water was tried but found to be too expensive.

- Mature vines did not need bare ground as they ignored the few weeds that surfaced under the drips.

- Young vines handled less competition with weeds for water.

- Cover crops for insect control/companion planting were not considered because insect pests were not a problem.

- In September, green weed was ploughed out between rows. A rotary hoe was then used to level out and incorporate the weed. The rotary speed was the same as the tractor speed for gentle action.

- In November, the rotary hoe was used on summer weeds and again lightly under the vines near the roots. A grader blade was used to move soil back under the vines. Some weed was buried.

- Weeds were then let go as there was little competition under dry conditions.

- Dodge out (using a small mower head on a tractor-powered articulated arm) was fine but needed a skilled operator - tiring in large vineyards.

**Case 2. Clare region:**

- Weeds which were difficult to control were slashed to a short height.

- 40 round bales per hectare were used as mulch under vines but mineralisation was found to use up nitrogen.
• One cultivation was used to keep ground bare during summer.

Case 3. Margaret River area:
“The results were encouraging. We controlled weeds by mechanical means and fertilised our vines by composts. The mechanised control of weeds was not new to me as when I started working in vineyards in South Australia there were no good herbicides which could be used (e.g. there was no Roundup® there was no Spray.Seed®).

We intend to plant some of the vines under a heavier than normal black plastic for a trial. We hope that the plastic will last for 4-5 years. The plastic is 75 microns whereby the normal black plastic is 50 microns. It is about 1m wide. The reason for the use of the plastic is that our German-made under-vine weeders require quite a large trunk on the vine to work without destroying vines. We hope that the black plastic will suppress the weeds until the trunks are sufficiently large enough to cope with the machinery we intend to use.”

Case 4. Margaret River area:
• Use mulch as much as possible - straw mulch, shredded paper and peat.
• Clemens undervine weeder was used to make hydraulic cuts just below surface shortly after emergence. This machine has a trigger mechanism to avoid cutting vines.
• Volunteers known in the organic industry as ‘Wwoofers’ (Willing Workers on Organic Farms) were employed for hand weeding.

Insect pest control
Insect control in organic vineyards must avoid synthetic chemicals and depend on natural means. Growers have a range of choices from which to create an integrated pest management program. These include use of extracts from natural materials, release or encouragement of insect predators or parasites, biological controls such as insect-attacking bacteria or viruses, pheromones, use of flowering cover crops to attract birds, and poultry running in the vineyard.

Pyrethrum (extracted from chrysanthemum, rotenone (from derris), garlic and seaweed extracts are among the substances permitted for insect control. A full list of substances is in Appendix 2. Other measures include:

• WaspS or mites that parasitise or attack pests, usually at the caterpillar stage, are preferred treatments. For example, Trichogramma wasps can be imported as eggs on cards to control caterpillars of pests such as lightbrown apple moth. In general, beneficial insects are encouraged by not spraying with broad-spectrum insecticides and by growing plants that provide food and shelter for them, either in cover crops or elsewhere near the vines. Also, WA vineyards may not have parasites of longtailed mealybug that occur in eastern Australia.

• Bacillus thuringiensis (BT) is a well-known control for caterpillar pests such as the light brown apple moth. It must be sprayed thoroughly and coincide with peak pest egg hatching and before the pests reach sheltered positions. The spray has to be eaten by the caterpillars and therefore will not work unless caterpillars are present.

• The predatory mite Typhlodromus doreenae has been used to control bunch mite. It appears to have resistance to sulphur sprays. In WA, Typhlodromus dossei is an important predator of grapeleaf rust mite.

• Pheromones (natural chemical sexual attractants) are commonly used to attract flying male moths and disrupt their breeding cycles. They are also used as an aid to monitoring pest numbers. Pheromones are available for lightbrown apple moth and heliothis.

• Poultry - usually guinea fowls, turkeys and chickens - are used against insect pests and snails in conventional as well as organic vineyards. They appear to be effective in control of the garden weevil, a major pest of vines, especially newly established vines. Poultry are most effective against wingless grasshopper. In most districts special efforts are necessary to protect poultry from foxes and/or dogs.
• While there are no proven ways of controlling black beetle, a major problem for vines up to about four years old, site preparation techniques may reduce the abundance of resident populations. Promoting quick vine growth helps to reduce the duration of susceptibility. Physical barriers, including aluminium foil or grow-guards, can prevent adults from accessing the stem where the feeding damage occurs. Black plastic along the rows has been suggested as a possible deterrent. Some of the plant extracts may also have a control benefit. Mounding soil at the base of damaged vines may save some plants that have not been severely attacked.

Garden weevil numbers can be reduced by removing favourable food plants such as the weeds sorrel and capeweed. Leaving water shoots on vines also helps to divert their feeding activity. A thick polybutane band on the butt of vines just below the crotch, on posts and wires will repel these flightless weevils from entering the vine canopy.

Growers' Notes

Comments on insect control:
• Light brown apple moth (LBAM) grubs are eaten by spiders in vineyard.
• Clear cultivation in September not only reduced competition but also removed a host of broad leaf weeds which harbour insects. This reduced hatching in October/November which had previously caused a lot of damage in vineyards.
• Small numbers of insects are tolerated as they do limited damage.
• Sulphur and oil has some effect on scale.
• One grower in Clare discovered a lot of spiders were present in his organic vineyard and winged grass hoppers had threatened but he decided not to spray. He found Bacillus thuringiensis hadn’t worked for the grasshoppers and Mimic was “OK”.
• LBAM can be controlled with Pheromone tags and by keeping broadleaf weeds down from October/November.
• Control of LBAM is very effective using Bacillus thuringiensis at peak egg hatching.
• Wasp and spiders are predators of LBAM. Adults must have nectar plants to live on as only larvae are parasitic. Some, such as Trichogramma sp., can be introduced.
• Bunch-mite has been controlled with Typhlodromus doreenaemy at Loxton.
• “In 1981, we had 25 acres of conventional vines. In 1988, we bought some new land, which we planted - only to be eaten by grasshoppers. In that season we spent a lot of money on chemicals. Consequently, we invested in guinea fowl to eat the grasshoppers. We had a few problems with the guinea fowl to begin with as foxes ate the first lot. However, we now have over 200 guinea fowl roaming over about 100 acres of vines. The grasshoppers are controlled and we do not have any weevil problems. Whether the small weevil numbers are due to the presence of the guinea fowl or not we are unsure but we are not complaining.”

Grapevine diseases

Disease control in organic vineyards depends on management techniques and use of a limited number of spray-on materials. Healthy vines grown in an environment that does not favour fungal pathogens are less likely to suffer severe damage than vines in conventional vineyards in disease prone areas - particularly vineyards with heavy leaf cover in high-moisture growing seasons. The best means of disease control in the long term is to initially choose fungus-resistant varieties which produce loose bunches. This is not always possible and if varieties are chosen for their suitability to a district or soil type, then good air drainage and open, well-exposed canopies will give good control of disease.

Excessive vigour, on the other hand, leads to shading of bunches, which favours disease. Excessive vigour may be controlled by irrigation and moisture control management techniques in combination with well-balanced fertiliser programs. Minimum pruning is also advocated by some as a way to reduce vigour in high rainfall areas. In these high vigour environments, they consider heavy pruning leads to dense vegetation and tight bunches, ideal for the disease Botrytis.

There may be a need to remove leaves from around bunches under minimum pruning.

Minimum pruning retains old wood, which may lead to some increase in phomopsis inoculum carryover. With minimum pruning, self-terminating tips and shoots should not be much more than 20cm in length.

Substances permitted to control fungal disease include wettable or dry sulphur, and copper in forms such as Bordeaux and Burgundy mixture. The organic industry is facing some concern in the future with the possibility of application rates of copper, sulphur and zinc being limited under European regulations. Your certifier can clarify permitted inputs.
A full list of materials permitted under the National Standards for Organic and Biodynamic Produce is given in Appendix 2.

**Major diseases**

**Downy mildew**

To counter this disease, it is recommended to provide an open canopy, carefully monitor weather conditions (the fungus needs 10°C temperature, 10 mm rainfall and 24 hours wet foliage for spores to move to foliage) and spray with Bordeaux mix as a protective treatment.

Copper sprays may be applied shortly before and after flowering and three weeks following flowering. More frequent applications may be needed, such as before forecast wet weather and before overhead irrigation. Timing and good coverage is important. Copper mixture has several problems, including the possibility of copper accumulation, and must be used with care.

There is no approved eradicant spray. The only effective spray the organic industry has used is phosphoric acid but its approval has been withdrawn. There is some possibility of mites being available to control downy mildew.

There are strong indications from Europe that the acidified clay products Myco-San® and Ulmasud® are useful in cool climates for control of downy mildew. However, they are not yet available in Australia.

Several bio-fungicides are being tested and imported which may have some use in a well-integrated disease management program in the future.

**Powdery mildew (oidium)**

The first defence against this disease is an open canopy that admits plenty of sunlight and reduces spore germination. Sulphur generally gives reasonable control. Lime sulphur may be sprayed during dormancy and just before budburst to kill over-wintering spores. Wettable sulphur sprays should be then be applied several weeks after budburst and continued at two to three-week intervals. However, it is desirable to monitor for signs of disease rather than undertake routine spraying.

A successful traditional treatment is the application of dusting sulphur during summer growth. Temperatures of 25-30°C are needed for the best results. Application in temperatures above 32°C can result in burning of foliage and berries.

Research from New Zealand indicates that a plant extract from Reynoutria sachalinensis (Knot weed) gives control of powdery mildew (Tassie, E., 1990). Other research has indicated that milk products have useful properties which control powdery mildew.

**Botrytis**

Botrytis, which causes bunch rot, is a major problem for organic growers because there are no effective specific fungicides permitted for control of this disease.

An open canopy, possibly accompanied by leaf removal around the fruiting area, is a defence against botrytis. Leaf removal should be done at the right time and not before veraison in hot climates. However, exposure to sun may lead to sunburn on fruit.

Loose bunches are desirable because berries in tight bunches are likely to split when damp and provide entry to the fungus, which then spreads rapidly. In extreme cases bunch thinning may be used.

Excess vigour produces lush vegetative growth which shades the bunches and encourages the fungus. In some cases vigour can be avoided by limiting nitrogen availability to the vines. Hard pruning also stimulates vegetative growth.

The fungus is more likely to attack berries damaged by birds or larvae of pests, such as the light brown apple moth. These should be controlled where possible. In the South West of Western Australia light brown apple moth may not be a major problem.

High concentrations of nitrogen can produce thinner skins on berries, which makes them more susceptible. Thicker skins inhibit Botrytis. Claims have been made that sprays derived from seaweed and fish waste have had some success in the control of botrytis.

Potassium metabisulphite applied as a spray can delay the development of botrytis in berries approaching harvest and is used as a ‘last resort’ against the disease.

**Growers’ Notes**

**Comments on disease management**

- Young vines needed to be sprayed for powdery mildew using sulphur (wettable powder any commercial line) and canola oil.
- Some leaf plucking was required around bunches on older vines.
- Sprays were applied on average every fortnight until hot
and dry conditions prevailed. In cool, wet conditions sprays were applied every 10 days.

- Started spraying just after bud burst. The first two sprays were a copper hydroxide/sulphur/oil mix. Then reverted to copper hydroxide - copper oxychloride is allowed but discouraged.
- Pruning used to allow air and light into bunch, reducing conditions for disease.
- All sprays are preventative there are no apparent control spraying.
- Copper/sulphur preventative sprays are used 4-5 times, some years 6-7 times.
- Copper hardens tissue, sulphur for powdery mildew at 1-8 kg wettable powder and copper hydroxide at 1-2 kg/hectare.
- Could model and monitor disease but is labour intensive. Prefer preventative treatment.
- Birds can be a big issue for small vineyards and nets may be essential. For large vineyards they become less of an issue - large areas of grapes dilute effect.
Winemaking

The organic grapes must be grown in compliance with the National Standard for Organic and Biodynamic Produce and the fruit must be certified by an organisation accredited by the Australian Quarantine Inspection Service (AQIS). The wine can then be produced and labelled either as ‘Wine Made from Organically Grown Grapes’ or ‘Organic Wine’.

Wine from organically grown grapes
Producers of wine made from organically grown grapes must be able to demonstrate an ‘audit trail’ linking the finished product to organically grown grapes. However, up to five per cent of the wine can be made of material derived from non-organic grapes to generate cultures of microorganisms or for topping up.

Wine made from organic grapes must be made according to standard winemaking procedures complying with Australian Food Standards Code Section P4.

Currently, ‘wine made from organically grown grapes’ is probably the main use of organically grown grapes - the market for organic wine is not generally considered to justify the extra effort involved in producing fully organic wine. However, it is possible that the extra effort involved in producing “organic” wine may be rewarded with additional premiums or access to some markets.

Organic winemaking
Organic wine is made from grapes certified Level A organically grown, made in compliance with Australian Food Standards Code P4. An ‘audit trail’ is required linking the wine to grapes certified as “organic” by an accredited organisation.

Harvesting: If the grapes are machine harvested, the harvester must be washed out with water prior to operation. The grapes must be harvested in a manner that prevents contamination with undesirable metals, plastics, chemicals or dust.

The time of day grapes are harvested will ultimately influence the quality of the wine. White wine grapes are often harvested in the cool of the night to prevent oxidation while red wine grapes may be allowed to warm up to allow full flavour development.

Transport: Organic grapes must be transported in uncontaminated containers. If the containers have been used for conventional grapes, they must be thoroughly cleaned out to avoid possible contamination before they are used for organic grapes. If transported any distance, the grapes may need protection using potassium metabisulphate.

Production: Organic winemakers are unable to use the full range of materials available for conventional winemaking so attention to hygiene and careful handling in the winery is paramount. However, organic winemaking techniques are much the same as those used for conventional winemaking.

At the winery, the grapes must be crushed without delay to prevent spoilage. Crushing equipment must be made of inert material (eg stainless steel). Inert equipment must also be used to drain and press the grapes. The crusher must be washed with water before processing an organic batch. Pectolytic enzymes may be used. Juice can be clarified by chilling and settling in the conventional manner.

Additives and processing/processing aids allowable for organic winemaking are listed in the following table. It is important to note that sulphur dioxide is acceptable as a preserving and anti-oxidation agent but free sulphur dioxide must not exceed 30 mg/L and total sulphur dioxide must not exceed 125 mg/L. It is allowed only in the gaseous form or as a solution of the gas. Ascorbic acid may also be used as an antioxidant.

Yeast for fermentation may be obtained from commercial sources but some makers prefer the yeast naturally present on the grapes. Larger populations of yeast are likely to be present on organically grown grapes than on grapes sprayed for pest and disease control.
After fermentation the wine may be clarified using most of the normal processes. Bentonite, egg white, isinglas, skim milk and gelatine are among fining materials that may be used to help clear and stabilise the wine. Use of inert gas - carbon dioxide or nitrogen - is encouraged to prevent contact with air at all stages of winemaking.

All handling and bottling equipment and procedures must be designed to minimise contamination or modification of the wine. Barrels may be cleaned only with water while sulphur dioxide should only be added to empty barrels in gaseous form.

Organic wines must be free of residual materials prohibited in regulations governing organic grape growing and winemaking for organic wine while also meeting the relevant Australian food standards.

The winemaker must keep detailed records of all winemaking activities, transfers and additions, and details of storage vessels used. The winery and bottling facilities must be inspected and certified by an accredited organisation before being used to produce organic wine. The winery or section of a larger winery used for organic wine should not be used for conventional wine production at the same time.

Organic wines should be kept separate from other wines. Inspectors are likely to be needed on-site when organic wine is bottled. Unfortunately, this can add to the cost, making certification of organic wine more expensive.

Winemakers must be prepared to also submit to subsequent inspections to ensure compliance with regulations and provide samples of wine for analysis as required.

Quality
The quality of the grapes determines the ultimate quality of the wine. There are many factors that influence both grape quality and the wine making process.

Simply described, the grape contains sugar, most of which is converted to alcohol during fermentation. The rest provides sweetness and balance. The grape also contains tannin and a range of compounds in the skin that determine colour, taste and smell. Many of these are an interaction between variety and the way the plant is grown.

Winemakers have specific requirements for sugar content (baume), acid level, damage to berries and other characteristics of the grapes they accept. Growers need to be aware of the requirements of makers, which may be more stringent for organic wines, where quality of the fruit is considered paramount.

High levels of irrigation can produce high yields, but quality may suffer - premium wines tend to be made from low-yielding vines. Small berries with a high proportion of skins, which may be produced in unirrigated vineyards, are often favoured for quality wine production.

High soil nitrogen concentrations lead to high yields but too much nitrogen may be undesirable because it increases vegetative growth and possible problems associated with excessive shading. However, low nitrogen in grape juice can lead to ‘stuck’ ferments, which are difficult to overcome in organic winemaking.

Labelling
If wine is labelled as ‘organic’, it must have been produced under approved conditions specified by the certifying body referred to on the label. This implies that the organisation concerned has inspected the vineyard and winery and certified them as Organic.

In many cases the winemaking process is not certified and wine is labelled only as ‘made from organically grown grapes’.

In addition, the standard wine industry conditions apply to organic wine. The Australian Wine and Brandy Corporation can conduct audits to ensure that wine meets these standards and is true to label.
### Table 1. Allowed additives and processing aids for the production of organic wine in Australia.
(extracted from The Organic Vigerons Association of Australia manual)

<table>
<thead>
<tr>
<th>Additives and Processing Aids</th>
<th>Processing Aids</th>
</tr>
</thead>
<tbody>
<tr>
<td>Activated carbon</td>
<td>Malic acid</td>
</tr>
<tr>
<td>Argon</td>
<td>Membrane filters</td>
</tr>
<tr>
<td>Ascorbic acid</td>
<td>Milk - skim</td>
</tr>
<tr>
<td>Bentonite</td>
<td>Milk - whole</td>
</tr>
<tr>
<td>Calcium alginate</td>
<td>Mistelle (fortified organic grape juice)</td>
</tr>
<tr>
<td>Calcium carbonate</td>
<td>Nitrogen</td>
</tr>
<tr>
<td>Cane sugar (for sparkling wine and vermouth)</td>
<td>Oxygen</td>
</tr>
<tr>
<td>Carbon dioxide</td>
<td>Oak pieces</td>
</tr>
<tr>
<td>Casein</td>
<td>Pectolytic enzymes</td>
</tr>
<tr>
<td>Citric acid</td>
<td>Potassium caseinate</td>
</tr>
<tr>
<td>Concentrated grape juice (organic)</td>
<td>Potassium carbonate</td>
</tr>
<tr>
<td>Copper sulphate</td>
<td>Potassium hydrogen carbonate</td>
</tr>
<tr>
<td>Diammonium phosphate</td>
<td>Potassium metabisulphite</td>
</tr>
<tr>
<td>Diatomaceous earth</td>
<td>Potassium tartrate</td>
</tr>
<tr>
<td>Egg white</td>
<td>PVPP</td>
</tr>
<tr>
<td>Evaporated milk</td>
<td>Silicon dioxide</td>
</tr>
<tr>
<td>Gelatine</td>
<td>Sulphur dioxide - gas</td>
</tr>
<tr>
<td>Grape alcohol</td>
<td>Sulphur dioxide - aqueous</td>
</tr>
<tr>
<td>Grape juice - organic</td>
<td>Tannic acid</td>
</tr>
<tr>
<td>Ion exchange resins (inert)</td>
<td>Tartaric acid</td>
</tr>
<tr>
<td>Isinglass</td>
<td>Thiamine and other vitamin supplements</td>
</tr>
<tr>
<td>Kaolin</td>
<td>Water (to a maximum limit of 3 per cent formixing additives)</td>
</tr>
<tr>
<td>Lactic acid</td>
<td>Yeast</td>
</tr>
<tr>
<td>Lactic acid bacteria</td>
<td></td>
</tr>
</tbody>
</table>

### Table 2. Allowed processes for the production of organic wine in Australia
(extracted from The Organic Vigerons Association of Australia manual)

<table>
<thead>
<tr>
<th>Processes</th>
<th>Heating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Setting</td>
<td>Filtration with approved media</td>
</tr>
<tr>
<td>Centrifugation</td>
<td>Treatment with inert gas (blanketing, sparging)</td>
</tr>
<tr>
<td>Chilling</td>
<td></td>
</tr>
</tbody>
</table>
Yields and costs

Yields
Growers entering the industry will benefit from some indication of relative yields obtained under organic conditions. Only limited data is available.

The material presented here is derived from several people and may give an indication. The actual yield you can or should obtain depends on growing conditions, varieties and use. It is also very much determined by the amount of light the vines and grapes are exposed to.

<table>
<thead>
<tr>
<th></th>
<th>Organic t/ha</th>
<th>Conventional t/ha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cabernet Sauvignon</td>
<td>8.8</td>
<td>8.3</td>
</tr>
<tr>
<td>Chardonnay</td>
<td>10.7</td>
<td>11.4</td>
</tr>
<tr>
<td>Merlot</td>
<td>8.9</td>
<td>10.7</td>
</tr>
<tr>
<td>Shiraz</td>
<td>7.7</td>
<td>8.3</td>
</tr>
</tbody>
</table>


Note: The table indicates a small reduction in yield for the organic grapes, except for Cabernet Sauvignon

Costs
Costs will also be important to new organic grape growers. The information presented is a limited indication and not designed as data for a financial plan. Cost are increased in organic viticulture because of increased labour inputs required by organic status.

Table 1. Costs reported from Southcorp (1996-97 financial year)

<table>
<thead>
<tr>
<th>Cost comparisons</th>
<th>E Block organic</th>
<th>F Block organic</th>
<th>A and C Blocks conventional</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total costs per ha</td>
<td>$7,801</td>
<td>$6,407</td>
<td>$5,124</td>
</tr>
<tr>
<td>Total cost per tonne</td>
<td>$998</td>
<td>$892</td>
<td>$490</td>
</tr>
</tbody>
</table>

Note: Materials and labour 65 per cent, overheads 35 per cent of costs.

One report in 1989 on organic viticulture indicated a five per cent extra requirement for labour and 15 per cent lower yields compared with conventional vineyards.
References


Acres Australia

Settlers Ridge grows into winemaking, Vol. 6 No. 1, 1998
Grape growers show natural ways work, Vol. 6 No. 1, 1998
Best way happens to be organic at Glenara, Vol. 4, No. 5, 1996
European flavour in Hastings River vineyards, Vol. 4 No. 4, 1996
Clare Estate scores on export market, Vol. 3, No. 5, 1995
Exports lead organic demand, August 1998
Grape growing using the ‘smaller toolkit’ of organics, Nov. 1998
Premier wine-maker moves to natural farming methods, Vol. 6, No. 8, 1998
Clare vineyard’s sparkling red one of the family successes, July 1998
Organic wine on the high ground, Vol. 6, No. 3, 1998
Temple Bruer opts for natural methods, Vol. 6, No. 1, 1998
Many benefits in cover crops, June 1999
Seven decades with little use of chemicals, March 1999
Organics influence wine styles, October 1999
Cultivation - a matter of how, not why, May 1999
Certification makes hard decisions easier, February 1999

Organic Vignerons Association of Australia Inc. ‘A manual governing the certification and control of organic grapes and wine’. OVAA, PO Box 503, Nurioopta SA 5355.


SeedCo 1999. Cover Crops A guide to species selection and sward management, SeedCo, 78 Burbridge Rd, Hilton, South Australia and Grape and Wine Research and development Corporation. (Various editions in different States.)
There are a number of organic wine grape producers and winemakers in Australia. This list has been derived from publicly available information and is not claimed to be complete.

<table>
<thead>
<tr>
<th>Name</th>
<th>Location</th>
<th>Certification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Southcorp</td>
<td>Penfolds Clare Valley, NASAA</td>
<td></td>
</tr>
<tr>
<td>Glenara</td>
<td>Adelaide Hills, South Australia, White and Red, OVAA</td>
<td></td>
</tr>
<tr>
<td>Settlers Ridge</td>
<td>Margaret River, Western Australia, White and Red, NASAA</td>
<td></td>
</tr>
<tr>
<td>Robinvale Wines</td>
<td>Robinvale Victoria - Demeter</td>
<td></td>
</tr>
<tr>
<td>Martins Hill Wines</td>
<td>Mudgee, New South Wales, OVAA</td>
<td></td>
</tr>
<tr>
<td>Cassegrain Vineyards</td>
<td>Port Macquarie, NSW (Chambourcin), BDRI, Demeter</td>
<td></td>
</tr>
<tr>
<td>Temple Bruer</td>
<td>Langhorne Creek, South Australia, OVAA</td>
<td></td>
</tr>
<tr>
<td>Botobolar</td>
<td>Mudgee, New South Wales, (no longer certified)</td>
<td></td>
</tr>
<tr>
<td>Jeanneret</td>
<td>Clare, South Australia</td>
<td></td>
</tr>
<tr>
<td>Serventy Wines</td>
<td>Margaret River, Western Australia, NASAA</td>
<td></td>
</tr>
<tr>
<td>Rosnay Organic Vineyard</td>
<td>Lachlan Valley, New South Wales (OVAA in Conversion)</td>
<td></td>
</tr>
<tr>
<td>Highbank</td>
<td>Coonawarra, South Australia (organic grown)</td>
<td></td>
</tr>
<tr>
<td>Eden Ridge</td>
<td>Mountadam wines, Eden Valley, South Australia</td>
<td></td>
</tr>
<tr>
<td>Wilkie Estate</td>
<td>Penfield, South Australia OVAA</td>
<td></td>
</tr>
<tr>
<td>Wynns Wines</td>
<td>Various States, OVAA</td>
<td></td>
</tr>
</tbody>
</table>
### Table 2. Approved winemaking substances

The following tables have been reproduced from The Organic Vignerons Association of Australia Manual.

**Allowed additives and processing aids for the production of organic wine in Australia.**

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<thead>
<tr>
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<td>PVPP</td>
</tr>
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<tr>
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<tr>
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<td>Tartaric acid</td>
</tr>
<tr>
<td>Isinglass</td>
<td>Thiamine and other vitamin supplements</td>
</tr>
<tr>
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<td>Water (to a maximum limit of 3 per cent for mixing additives)</td>
</tr>
<tr>
<td>Lactic acid</td>
<td>Yeast</td>
</tr>
<tr>
<td>Lactic acid bacteria</td>
<td></td>
</tr>
</tbody>
</table>

**Allowed processes for the production of organic wine in Australia**

<table>
<thead>
<tr>
<th>Setting</th>
<th>Heating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Centrifugation</td>
<td>Filtration with approved media</td>
</tr>
<tr>
<td>Chilling</td>
<td>Treatment with inert gas (blanketing, sparging)</td>
</tr>
</tbody>
</table>
Appendix 1. Organic industry certification organisations accredited by AQIS as of January 2000

Bio-Dynamic Research Institute
POWELLTOWN VIC 3797
Phone: (03) 5966 7333
Fax: (03) 5966 7433

Biological Farmers of Australia Co-Operative Ltd
PO Box 3404
TOOWOOMBA VILLAGE FAIR QLD 4350
Phone: (07) 4639 3299
Fax: (07) 4639 3755
E-mail: bfa@icr.com.au

National Association for Sustainable Agriculture (Australia) Ltd
PO Box 768
STIRLING SA 5152
Phone: (08) 8370 8455
Fax: (08) 8370 8381
E-mail: nasaa@dove.mtx.net.au

Organic Herb Growers of Australia Inc.
PO Box 6171
SOUTH LISMORE NSW 2480
Phone: (02) 6622 0100
Fax: (02) 6622 0900
E-mail: herbs@lis.net.au

Organic Vignerons Association of Australia Inc.
1 Gawler Street
(PO Box 503)
NURIOOTPA SA 5355
Phone: (08) 8562 2122
Fax: (08) 8562 3034
E-mail: boss@dove.net.au

Organic Food Chain
PO Box 2390
TOOWOOMBA QLD 4350
Phone: (07) 4637 2600
Fax: (07) 4696 7689
E-mail: organicfoodchain@hotmail.com

Tasmanian Organic-Dynamic Producers
PO Box 434
MOWBRAY HEIGHTS TAS 7248
Phone: (03) 6383 4039
Fax: (03) 6383 4594
E-mail: plowe@vision.net.au

For more information on the production and marketing of Australian organic produce, contact the Organic Federation of Australia at the address below:

Organic Federation of Australia
P.O. Box Q455
QVB Post Office
SYDNEY NSW 1230
Phone: (02) 9299 8016
Fax: (02) 9299 0189
E-mail: info@ofa.org.au

Organic Retailers and Growers Association
PO Box 12852
MELBOURNE VIC 3000
Phone: (03) 9737 9799
Fax: (03) 9737 9499
Toll Free: 1800 356 299
E-mail: oas@alphalink.com.au
### Appendix 2. Input products for use in organic production

*(From: National Standards for Organic and Biodynamic Produce)*

#### 2.1 Permitted materials for use in soil fertilising and soil conditioning

**A. Materials permitted for use in organic and biodynamic farming**

<table>
<thead>
<tr>
<th>Substances</th>
<th>Specific conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slurry from certified sources</td>
<td>-</td>
</tr>
<tr>
<td>Aerobic compost</td>
<td>Compost is the conversion of organic materials into humus colloids</td>
</tr>
<tr>
<td>Anaerobic compost</td>
<td>-</td>
</tr>
<tr>
<td>Straw</td>
<td>-</td>
</tr>
<tr>
<td>Mined carbon-based products such as peat, or coal</td>
<td>-</td>
</tr>
<tr>
<td>Blood and bone, fish meal, hoof and horn meal, or other waste products from fish or animal processing</td>
<td>-</td>
</tr>
<tr>
<td>Seaweed or seaweed meal</td>
<td>-</td>
</tr>
<tr>
<td>Plant and animal derived by-products of the food and textile industries</td>
<td>-</td>
</tr>
<tr>
<td>Sawdust, bark and wood waste</td>
<td>From untreated sources</td>
</tr>
<tr>
<td>Basic slag only</td>
<td>Only after residue testing for heavy metals</td>
</tr>
<tr>
<td>Dolomite and lime</td>
<td>From natural sources</td>
</tr>
<tr>
<td>Gypsum (calcium sulphate)</td>
<td>From natural sources</td>
</tr>
<tr>
<td>Calcined or rock phosphate and other crushed mineral bearing rocks</td>
<td>Excluding those minerals which are more than 20 per cent soluble</td>
</tr>
<tr>
<td>Phosphoric guano</td>
<td>-</td>
</tr>
<tr>
<td>Rock potash and sulphate potash</td>
<td>-</td>
</tr>
<tr>
<td>Wood ash</td>
<td>From untreated sources</td>
</tr>
<tr>
<td>Sulphur</td>
<td>-</td>
</tr>
<tr>
<td>Clay, bentonite</td>
<td>-</td>
</tr>
<tr>
<td>Attapulgite</td>
<td>-</td>
</tr>
<tr>
<td>Perlite</td>
<td>-</td>
</tr>
<tr>
<td>Trace elements includes materials such as borax. Natural chelates are acceptable, e.g. ligno sulphonates and those using the natural chelating agents such as citric, malic, tartaric and other di- and tri- acids</td>
<td>Not synthetically chelated elements</td>
</tr>
<tr>
<td>Homeopathic preparations</td>
<td>-</td>
</tr>
<tr>
<td>Approved microbiological and biological preparations</td>
<td>-</td>
</tr>
<tr>
<td>Naturally occurring biological organisms (e.g. worms and worm castings)</td>
<td>Excluding products derived from genetic modification technology</td>
</tr>
<tr>
<td>Fish products</td>
<td>-</td>
</tr>
<tr>
<td>Zeolites</td>
<td>-</td>
</tr>
<tr>
<td>Vermiculite</td>
<td>-</td>
</tr>
<tr>
<td>Potassium glauconite</td>
<td>-</td>
</tr>
</tbody>
</table>
## 2.2 Permitted materials for plant pest and disease control

<table>
<thead>
<tr>
<th>Substances</th>
<th>Specific conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pyrethrum extracted from <em>Chrysanthemum cinerariaefolium</em></td>
<td>Without piperonyl butoxide</td>
</tr>
<tr>
<td>Rotenone extracted from <em>Derris elliptica</em></td>
<td>-</td>
</tr>
<tr>
<td>Quassia extracted from <em>Quassia armara</em></td>
<td>-</td>
</tr>
<tr>
<td>Neem oil and extracts</td>
<td>-</td>
</tr>
<tr>
<td>Rynia extracted from <em>Rynia speciosa</em></td>
<td>-</td>
</tr>
<tr>
<td>Propolis</td>
<td>-</td>
</tr>
<tr>
<td>Diatomaceous earth</td>
<td>In non-heat treated form</td>
</tr>
<tr>
<td>Stone meal</td>
<td>-</td>
</tr>
<tr>
<td>Meta-aldehyde baits</td>
<td>In traps or enclosed from the environment</td>
</tr>
<tr>
<td>Baits for fruit fly</td>
<td>Substances as required by statutory regulation and must be fully enclosed within traps</td>
</tr>
<tr>
<td>Copper, in forms such as Bordeaux mixture and Burgundy mixture</td>
<td>Hydroxide is the preferred form except for Bordeaux on dormant tissue</td>
</tr>
<tr>
<td>Sulphur in a wettable or dry form</td>
<td>-</td>
</tr>
<tr>
<td>Sodium silicate (waterglass)</td>
<td>-</td>
</tr>
<tr>
<td>Sodium bicarbonate</td>
<td>-</td>
</tr>
<tr>
<td>Potassium soap (soft soap)</td>
<td>-</td>
</tr>
<tr>
<td>Biological controls</td>
<td>Naturally occurring organisms and approved cultured organisms such as <em>Bacillus thuringiensis</em></td>
</tr>
<tr>
<td>Pheromones</td>
<td>-</td>
</tr>
<tr>
<td>Granulose virus preparations</td>
<td>-</td>
</tr>
<tr>
<td>Essential oils</td>
<td>-</td>
</tr>
<tr>
<td>Vegetable oils</td>
<td>-</td>
</tr>
<tr>
<td>Light mineral oils (white oil)</td>
<td>-</td>
</tr>
<tr>
<td>Seaweed, seaweed meal, seaweed extracts, sea salts and salty water</td>
<td>-</td>
</tr>
<tr>
<td>Homoeopathic preparations</td>
<td>-</td>
</tr>
<tr>
<td>Natural plant extracts, excluding tobacco, such as garlic extract, etc. and used as a repellent, antifeedant or pest/disease control</td>
<td>Obtained by infusion and made by the farmer without additional concentration</td>
</tr>
<tr>
<td>Potassium permanganate</td>
<td>-</td>
</tr>
<tr>
<td>Carbon dioxide and nitrogen gas</td>
<td>-</td>
</tr>
<tr>
<td>Vinegar</td>
<td>-</td>
</tr>
<tr>
<td>Wetting agents</td>
<td>Caution needs to be exercised with product which may be contained in some commercial formulations of the above products. Acceptable wetting agents include some seaweed products and plant products</td>
</tr>
</tbody>
</table>


### 2.2 (cont) Permitted material for animal pest and disease control

<table>
<thead>
<tr>
<th>Substances</th>
<th>Specific conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pyrethrum extracted from <em>Chrysanthemum cinerariaefolium</em></td>
<td>Without piperonyl butoxide</td>
</tr>
<tr>
<td>Rotenone extracted from <em>Derris elliptica</em></td>
<td>-</td>
</tr>
<tr>
<td>Quassia extracted from <em>Quassia armara</em></td>
<td>-</td>
</tr>
<tr>
<td>Neem oil and extracts</td>
<td>-</td>
</tr>
<tr>
<td>Garlic oil, garlic extract or crushed garlic</td>
<td>-</td>
</tr>
<tr>
<td>Seaweed, seaweed meal, seaweed extracts, sea salts and salty water</td>
<td>-</td>
</tr>
<tr>
<td>Sulphur</td>
<td>-</td>
</tr>
<tr>
<td>Potassium permanganate</td>
<td>Homoeopathic preparations</td>
</tr>
<tr>
<td>Natural plant extracts obtained by infusion</td>
<td>Excluding tobacco</td>
</tr>
<tr>
<td>Essential oils</td>
<td>-</td>
</tr>
<tr>
<td>Methylated spirits</td>
<td>-</td>
</tr>
<tr>
<td>Tallow</td>
<td>-</td>
</tr>
<tr>
<td>Cider vinegar</td>
<td>Certified organic</td>
</tr>
<tr>
<td>Nettle</td>
<td>-</td>
</tr>
<tr>
<td>Diatomaceous earth</td>
<td>Non heat-treated form</td>
</tr>
<tr>
<td>Selenium and other trace elements</td>
<td>To correct identified deficiencies only</td>
</tr>
<tr>
<td>Zinc sulphate</td>
<td>-</td>
</tr>
<tr>
<td>Copper sulphate</td>
<td>-</td>
</tr>
<tr>
<td>Vitamins</td>
<td>-</td>
</tr>
<tr>
<td>Biological controls</td>
<td>-</td>
</tr>
<tr>
<td>Charcoal</td>
<td>-</td>
</tr>
<tr>
<td>Clay</td>
<td>-</td>
</tr>
<tr>
<td>Vaccines</td>
<td>May be used only for a specific disease which is known to exist on the organic farm or neighbouring farms and which threatens livestock health and which cannot be effectively controlled by other management practices</td>
</tr>
<tr>
<td>Wetting agents</td>
<td>Caution needs to be exercised with product which may be contained in some commercial formulations of the above products. Acceptable wetting agents include some seaweed products and plant products</td>
</tr>
</tbody>
</table>
2.3 Substances permitted as post-harvest/storage treatments

<table>
<thead>
<tr>
<th>Substances</th>
<th>Specific conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Controlled atmosphere</td>
<td>Carbon dioxide oxygen nitrogen</td>
</tr>
<tr>
<td>Ripening agents</td>
<td>Ethylene gas</td>
</tr>
<tr>
<td>Pest control</td>
<td>Physical barriers; temperature control; diatomaceous earth; rodenticides; sticky boards.</td>
</tr>
</tbody>
</table>

* Rodenticides must be in enclosed traps outside of food processing and/or storage areas and only where harbour reduction and physical barriers have proved ineffective. Traps should be checked regularly and the baits changed.
## 2.4 Substances permitted as food additives, including carriers

### B1. Food additives, including carriers

<table>
<thead>
<tr>
<th>INS</th>
<th>Name</th>
<th>Specific conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>170</td>
<td>Calcium carbonates</td>
<td></td>
</tr>
<tr>
<td>220</td>
<td>Sulphur dioxide</td>
<td></td>
</tr>
<tr>
<td>224</td>
<td>Potassium metabisulphite</td>
<td></td>
</tr>
<tr>
<td>270</td>
<td>Lactic acid</td>
<td></td>
</tr>
<tr>
<td>290</td>
<td>Carbon dioxide</td>
<td></td>
</tr>
<tr>
<td>296</td>
<td>Malic acid</td>
<td></td>
</tr>
<tr>
<td>300</td>
<td>Ascorbic acid</td>
<td></td>
</tr>
<tr>
<td>306</td>
<td>Tocopherols (antioxidant)</td>
<td></td>
</tr>
<tr>
<td>322</td>
<td>Lecithin</td>
<td></td>
</tr>
<tr>
<td>330</td>
<td>Citric acid</td>
<td></td>
</tr>
<tr>
<td>331</td>
<td>Sodium citrate (canned meat products)</td>
<td>Acidity regulator, emulsifier, sequestrant, stabiliser</td>
</tr>
<tr>
<td>332</td>
<td>Potassium citrate (meat products)</td>
<td></td>
</tr>
<tr>
<td>333</td>
<td>Calcium citrate (meat products)</td>
<td>Acidity regulator, filming agent, sequestrant</td>
</tr>
<tr>
<td>334</td>
<td>Tartaric acid (for wine)</td>
<td></td>
</tr>
<tr>
<td>335</td>
<td>Sodium tartrate</td>
<td></td>
</tr>
<tr>
<td>336</td>
<td>Potassium tartrate</td>
<td></td>
</tr>
<tr>
<td>341</td>
<td>Mono calcium phosphate</td>
<td>Only for raising flour</td>
</tr>
<tr>
<td>342</td>
<td>Ammonium phosphate</td>
<td>Yeast improver</td>
</tr>
<tr>
<td>400</td>
<td>Alginic acid</td>
<td></td>
</tr>
<tr>
<td>401</td>
<td>Sodium alginate</td>
<td></td>
</tr>
<tr>
<td>402</td>
<td>Potassium alginate</td>
<td></td>
</tr>
<tr>
<td>406</td>
<td>Agar</td>
<td></td>
</tr>
<tr>
<td>410</td>
<td>Locust bean gum</td>
<td></td>
</tr>
<tr>
<td>412</td>
<td>Guar gum</td>
<td></td>
</tr>
<tr>
<td>413</td>
<td>Tragacanth gum</td>
<td></td>
</tr>
<tr>
<td>414</td>
<td>Arabic gum</td>
<td></td>
</tr>
<tr>
<td>415</td>
<td>Xanthium gum</td>
<td>Thickener, stabiliser</td>
</tr>
<tr>
<td>416</td>
<td>Karaga gum</td>
<td></td>
</tr>
<tr>
<td>440</td>
<td>Pectins (unmodified)</td>
<td></td>
</tr>
<tr>
<td>450</td>
<td>Disodium diphosphate</td>
<td>Sequestrant, acidity regulator, texturiser</td>
</tr>
<tr>
<td>500</td>
<td>Sodium carbonates</td>
<td></td>
</tr>
<tr>
<td>501</td>
<td>Potassium carbonates</td>
<td></td>
</tr>
<tr>
<td>503</td>
<td>Ammonium carbonates</td>
<td></td>
</tr>
<tr>
<td>504</td>
<td>Magnesium carbonates</td>
<td></td>
</tr>
<tr>
<td>508</td>
<td>Potassium chloride</td>
<td>Gelling agent</td>
</tr>
<tr>
<td>509</td>
<td>Calcium chloride</td>
<td>Firming agent</td>
</tr>
<tr>
<td>511</td>
<td>Magnesium chloride</td>
<td>Firming agent</td>
</tr>
<tr>
<td>516</td>
<td>Calcium sulfate</td>
<td>Carrier</td>
</tr>
<tr>
<td>517</td>
<td>Ammonium sulphate</td>
<td>Flour treatment stabiliser</td>
</tr>
<tr>
<td>524</td>
<td>Sodium hydroxide</td>
<td>Acidity regulator</td>
</tr>
<tr>
<td>938</td>
<td>Argon</td>
<td></td>
</tr>
<tr>
<td>941</td>
<td>Nitrogen</td>
<td></td>
</tr>
<tr>
<td>948</td>
<td>Oxygen</td>
<td></td>
</tr>
</tbody>
</table>
B2. **Flavourings**
Substances and products labelled as natural flavouring substances or natural flavouring preparations as defined in the Australian/ New Zealand Food Standards Code.

B3. **Water and salts**
- Drinking water
- Salts (with sodium chloride or potassium chloride as basic components generally used in food processing).

B4. **Preparations of micro-organisms**
Any preparations of micro-organisms normally used in food processing, with the exception of micro-organisms genetically modified.

B5. **Minerals (including trace elements) and vitamins**
Only approved in-so-far as their use is legally required in the food products in which they are incorporated.
### Substances permitted as processing aids

<table>
<thead>
<tr>
<th>Names</th>
<th>Specific conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calcium chloride</td>
<td>Coagulation agent</td>
</tr>
<tr>
<td>Calcium carbonate</td>
<td>-</td>
</tr>
<tr>
<td>Calcium hydroxide</td>
<td>-</td>
</tr>
<tr>
<td>Calcium sulphate</td>
<td>Coagulation agent</td>
</tr>
<tr>
<td>Sulphur dioxide</td>
<td>For wine making only</td>
</tr>
<tr>
<td>Copper Sulphate</td>
<td>For wine making only</td>
</tr>
<tr>
<td>Magnesium chloride (or nigari)</td>
<td>Coagulation agent</td>
</tr>
<tr>
<td>Potassium carbonate</td>
<td>Drying of raisins</td>
</tr>
<tr>
<td>Carbon dioxide</td>
<td>-</td>
</tr>
<tr>
<td>Lecithin</td>
<td>Greasing agent</td>
</tr>
<tr>
<td>Nitrogen</td>
<td>-</td>
</tr>
<tr>
<td>Citric acid</td>
<td>Unrestricted</td>
</tr>
<tr>
<td>Ethanol</td>
<td>Solvent</td>
</tr>
<tr>
<td>Lactic acid</td>
<td>For meat products stabiliser</td>
</tr>
<tr>
<td>Tannic acid</td>
<td>Filtration aid</td>
</tr>
<tr>
<td>Egg white albumin</td>
<td>-</td>
</tr>
<tr>
<td>Casein</td>
<td>-</td>
</tr>
<tr>
<td>Gelatine</td>
<td>-</td>
</tr>
<tr>
<td>Isinglass</td>
<td>-</td>
</tr>
<tr>
<td>Vegetable oils</td>
<td>Greasing or releasing agent</td>
</tr>
<tr>
<td>Silicon dioxide (gel) or colloidal solution</td>
<td>-</td>
</tr>
<tr>
<td>Activated carbon</td>
<td>-</td>
</tr>
<tr>
<td>Talc</td>
<td>-</td>
</tr>
<tr>
<td>Bentonite</td>
<td>-</td>
</tr>
<tr>
<td>Kaolin</td>
<td>-</td>
</tr>
<tr>
<td>Diatomaceous earth</td>
<td>-</td>
</tr>
<tr>
<td>Perlite</td>
<td>-</td>
</tr>
<tr>
<td>Hazelnut shells</td>
<td>-</td>
</tr>
<tr>
<td>Beeswax</td>
<td>-</td>
</tr>
<tr>
<td>Carnauba wax</td>
<td>Releasing agent</td>
</tr>
<tr>
<td>Sodium carbonate (flour industry)</td>
<td>Anti-caking agent</td>
</tr>
<tr>
<td>Tartaric acid and salts (wine industry)</td>
<td>Stabilisers, sequestrants</td>
</tr>
<tr>
<td>Gelatine (fruit and vegetable products)</td>
<td>-</td>
</tr>
<tr>
<td>Water (unrestricted)</td>
<td>-</td>
</tr>
<tr>
<td>Oak Chips (untreated)</td>
<td>For wine making only</td>
</tr>
<tr>
<td>Preparations of micro-organisms and enzymes</td>
<td>Any preparations of micro-organisms and enzymes normally used as processing aids in food processing, with the exception of genetically modified organisms and enzymes.</td>
</tr>
</tbody>
</table>
Appendix 3.

Understanding soil conditions:
Alternative concepts

Management of soil fertility for biological systems has attracted a number of alternative approaches to understanding soil conditions and plant growth. The following outlines indicate several concepts for consideration.

Dr Rudolf Steiner - was the initiator of the concepts that form the basis of biodynamic agriculture. Biodynamic farming is a method designed biologically to activate the life of soil and plants. Plants are fed naturally through the soil ecosystem and not primarily via soluble salts in the soil water. Essential features relate to the use of special preparations and other techniques that enhanced soil biological activity, humus formation and soil structural development as the basis for allowing plants to selectively assimilate nutrients as dictated by sun warmth and light.

Dr William Albrecht - was primarily concerned with a soil fertility approach based on nutrient balance (or ratios) as the foundation for achieving proper fertility relevant to optimal plant growth. The nutrient balance equations he developed are related to soil total exchange capacity. Ideal ratios or percentages of cations and anions are defined for different soil types, with the total availability of these nutrients generally increasing (except magnesium and manganese) with their percentage saturation. The optimal base saturation (cation exchange) ratios are 60 per cent Ca, 20 per cent Mg on sandy soil and 70 per cent Ca, 10 per cent Mg on heavy soil, 3-5 per cent K, 10-15 per cent H and 2-4 per cent for other bases. The relative values and relationship between nutrients, especially Ca and Mg is considered of great importance.

Dr Carey Reams and Dr Phil Callaghan - this work is based on the concept of defining the potential for plant growth and fertiliser performance in terms of energy release and energy exchange. The contention is that fertilisers in themselves did not stimulate plant growth. It was the energy released (electromagnetic influence or paramagnetic energy fields) from these fertilisers that enhanced production. A distinction is made between fertilisers (nutrients) that produce growth energy, i.e. calcium, potash, chlorine, and nitrate nitrogen, to those that produce reproductive (fructifying energy), i.e. ammonium nitrogen, sulphate sulfur, manganese and phosphate. The approach also involves a proposition that the nutrient energy potential was dependent on microbial activity, and that energy availability is determined by nutrient balance. The approach also argues that phosphate is the primary catalyst in photosynthesis and subsequent plant sugar production. Increasing sap sugar levels (brix) is believed to reduce susceptibility to pest and disease attack and that plant sap sugar levels is directly related to plant pest and disease susceptibility.

Various approaches and analyses relating soil conditions and plant growth continue to be developed and a vast array of alternative input products are available. Scientific verification of many of these contentions and products has yet to be established. As a consequence the decision to adopt particular approaches tends to rely on anecdotal information and experience rather than rigorous scientific testing and understanding.