

organic

vegetables

a guide to production



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important disclaimer

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Contents

Introduction

- Conversion is a gradual process
- About this guide

Market outlook for organic vegetables

- Export markets
- Australian markets
- Organic certified and quality assured
- The United Kingdom model

General Principle for Organic Vegetable Production

- A whole system approach
- Enterprises aim to become closed systems
- Sustainable cropping rotations
- Plant health stems from soil health
- Biological processes are important
- Part certification of a property can aid conversion
- Minimum qualifying period
- Avoid contamination and spray drift
- Genetic engineering is banned
- Co-existence with, and protection of the environment
- Irrigation management
- Post harvest, storage and processed products

Making the change to organic

- Selecting a site

Organic vegetable production methods

- Rotations
- Soil fertility and nutrient inputs
- Sources of nutrients
- Weed management
- Pest and disease management

Organic standards and certification

- Background – organic and biodynamic regulations in Australia
- General requirements for organic certification
- How to gain organic certification

Further reading

Appendix 1 - Organic industry certifying organisations

Appendix 2 - Input products for use in organic production

Appendix 3 - Alternative approaches to soil management

Introduction

There appears to be considerable opportunity for the development of organic vegetable production in Western Australia for either fresh or processed product. While a number of growers are successfully producing relatively small quantities of organic vegetables for both domestic and export markets, few large scale commercial growers have sought to capitalise on this opportunity.

Consumer interest in organically grown vegetables has increased rapidly in recent years due largely to concerns relating to food safety, health and the environment. For more information on markets for organic vegetables refer to AGWEST publication “*Market Prospects – Organic Carrots and other Vegetables*”.

Conversion is a gradual process

Conversion from a conventional vegetable operation to an organic system may require significant changes in management approach, techniques and inputs used. These changes usually take several seasons to establish and involve more than simply avoidance of synthetic chemicals and fertilizers.

Growers already using Integrated Pest Management and Integrated Weed Management techniques may find changes required less dramatic, although changes to nutrient management can be significant.

Managing an organic system can require close attention to detail, and possibly more time and effort monitoring different indicators of the systems’ balance. To optimise management effectiveness, organic growers adopt a holistic approach when evaluating and predicting the consequences of any decision, especially with respect to pest, disease, weed and nutrient management.

Growers may find that setting aside a small area for developing organic production is a practical way to minimise commercial risk during the transitional phase, while gaining experience and confidence in an organic management system.

Motivation and commitment to the principles of organic farming, beyond the essential financial and market perspective, are regarded as key requirements for success.

In developing an organic system, the cropping rotation is likely to require production of a range of different vegetables grown using organic methods. The selection of other crops to be grown in rotation can have important management implications. In addition, these other rotational crops must also have reliable

organic markets if returns from developing an organic system are to be optimised.

As with conventional production, maintaining a reliable supply of product that consistently conforms to buyer quality criteria is essential for developing and retaining markets. Producing a product with superior flavour, and other eating qualities, can be very valuable in distinguishing the organic product from others in the market and reinforces consumer perceptions that organic products should taste better. Incorporating a quality assurance system, as part of the organic operation, may be important to ensure product quality is maintained in every consignment.

Consistent, year round, supply of organic vegetables is lacking throughout Australia partly because of the small number of producers. As a consequence, establishing new markets, both domestic or export, has been seriously hampered. There may be considerable benefit for new organic growers in forming strategic alliances with other organic growers, as a way of extending supply capability. These alliances should facilitate the capture of new markets, and provide a means of sharing knowledge and resources to improve management systems.

About this guide

Due to the great variation in location and types of vegetable production in Western Australia, only a general outline of organic vegetable production is possible in this guide.

This guide aims to provide a general outline for conventional vegetable growers with an interest in producing vegetables grown organically in compliance with the Australian “National Standards for Organic and Biodynamic Produce” and certified by an accredited organic inspection organisation (see Appendix 1).

The material presented comes from a wide, but by no means exhaustive, range of sources including a number of experienced commercial organic vegetable growers.

Growers will also need to consider organic methods applicable to other crops or livestock produced on the farm if whole farm certification is the aim. Further consideration will need to be given to management concerns not covered in this guide such as farm economic outcomes and financial considerations, and changes to capital plant and equipment.

Market outlook for organic vegetables

Export markets

Fresh produce remains the dominant sector of organic food consumption in the major world markets of Europe, USA and Japan. In addition, the rapid growth in processed and convenience organic foods suggests good prospects for a wide range of organic vegetables.

Opportunity is reported to currently exist for supply to Singapore and Malaysian markets, typically in mixed vegetable and fruit airfreight consignments. Considerable market inquiry from South East Asian countries notably Singapore and Malaysia as well as from Japan suggest good export market prospects exist for fresh and processed vegetables.

Existing Australian exports of carrots to Japan appears to be seasonal, suggesting the possibility of expanding this trade if year round supply could be offered. Strong market interest is apparent in the UK for carrot and other vegetable juices. Frozen organic vegetables have been identified as having good market prospects in the UK, Germany, France and Japan.

Australian markets

Within the Western Australian market the specialty “health food” sector is the traditional and main current market. Sales volumes tend to be relatively small and while the number of stores offering organic fresh produce has increased, growth in sales volumes is likely to be limited.



Organic speciality retailer - fresh produce display

Greengrocer/growers’ markets are increasingly interested in offering organic fresh produce. Major supermarkets have renewed interest in offering a range of organic produce. Some of the leading stores already have organic sections but generally are frustrated by inadequate supply and high prices.

Eastern Australian markets are further developed than in Western Australia. Potentially there exists an opportunity to supply vegetables during periods of limited local supply on the eastern seaboard.

In addition interstate wholesalers indicated an interest in obtaining year round supply of selected organic vegetables from WA if reliable supply could be established. A number of these wholesale agents are attempting to satisfy the expanding needs of major supermarkets and consistent supply of quality product would enable rapid development of this market sector.

Organic certified and quality assured

Most markets will only buy products certified as organic or biodynamic by a recognised certification organisation, whose symbol can be displayed on product packaging. These are the only products that can be legally labelled organic for export. While markets for full ‘organic’ are growing strongly, markets for products certified as ‘in conversion’ to organic (that is, less than three years since conversion) may be less certain and careful assessment may be required to verify demand and price premiums.

In the United Kingdom, leading supermarkets such as Waitrose sell ‘in conversion’ produce under their generic organic logo with words on the packaging explaining that the food is ‘in conversion’ and what that means. Customers are happy to pay the premium price knowing the food has not been grown with chemicals and that it is the ‘next best thing’ when full organic food is not available.

To maintain organic integrity throughout the supply chain, all points must comply with organic standards. This applies to storage, handling, transport and processing, which must ensure that organic product remains uncontaminated and separated from conventional.

Quality assurance (in addition to organic certification), based on a well-recognised scheme such as SQF 2000 can provide buyers with a higher degree of certainty that the product will conform to their specification quality criteria. A quality management system compatible with Hazard Analysis and Critical Control Points (HACCP) principles should also be an integral part of an organic production system.

The United Kingdom model

Evidence in the United Kingdom suggests that domestic demand for organic foods could suddenly soar and the market maintain

rapid growth rates over several years. The total market has maintained an annual growth rate of over 40 per cent for several years now after an initial sudden boom in the late 1990s.

Motivating factors there have included food scares (such as BSE, pesticide and dioxin residues, and E coli and salmonella outbreaks) and increased media focus on reported organic benefits and issues such as genetically engineered foods.

Organic foods quickly moved from 'fringe' to 'trendy', and then to mainstream in the United Kingdom within three to four years starting from 1997-1998. Chefs, nutritionists, celebrities, food writers, specialist organic supermarkets and opportunistic traders helped turn organic trendy.

Then major supermarkets including Sainsbury's, Waitrose and Tesco with their large customer bases made it mainstream - competing in-store (with promotions, brochures, organic shops within stores and own label ranges) and in the media for organic content – signing five-year contracts to take all production from some individual farmers. They also provided funding for producer clubs and conferences for information exchange, and funding organic research and development.

As competition increased between organic brands and between companies for markets and new product development, so did the amount and sophistication of promotion and advertising of organic - benefiting everyone in the organic food chain.

Organic retailers (including home delivery companies using the Internet), restaurants, cafes, consumer and trade shows and magazines multiplied, generating further demand. Farmers' markets spread around the country, giving farmers direct, regular access to consumers in most major towns and cities.

Many organic vegetable growers added value to their enterprise by developing own brand, partially processed produce and other products (many of them aimed at the booming children and concerned parent market), and by supplying product for supermarket own label brands.

Market trends experienced in the United Kingdom may well be repeated in Australia.

General Principles for Organic Vegetable Production

This section outlines the general principles that underlie organic vegetable production systems. Aspects of organic standards specific to vegetable production are highlighted.

A whole system approach

Production of one specific vegetable crop must be considered as only one component of an integrated whole farm system. Organic vegetable production will typically comprise of a rotations that involves crops from unrelated botanical families, as well as soil regenerating pasture or green manure phases and the use of other plants species that assist in pest, disease or weed control. The whole system is designed and managed to optimise benefits to future crops arising from previous crops and treatments. The layout of cropped areas may change towards more mixed cropping as a way of breaking up large areas of a single crop, thereby increasing biodiversity and assisting pest or disease management.

Enterprises aim to become closed systems

Organic farms aim to operate as closed systems, using renewable resources wherever possible, maximise recycling, minimise waste, and reduced reliance on outside (off-farm) inputs as far as practical. Management strategies based on an understanding of biological cycles and other interactions are the main tools that replace reliance on synthetic chemical inputs. Organic farms can be managerially more complex, but should be less dependent on the use of external inputs.

Sustainable cropping rotations

The intensive nature of vegetable production, in terms of land use, requires mixed and diverse cropping regimes and rotations in order to maintain and develop soil structure, to optimise the use of soil nutrient pools, and to minimise pests, diseases and weeds.

Within the rotation, no crop of the same or similar species, family or characteristic should be planted more than twice within a 5 crop rotation. Continuous cropping with the same or related crop, or short rotations with another crop, is unlikely to be acceptable as a sustainable organic farming system.

The crop rotation should include a green manure crop, leguminous crop or a pasture ley phase to regenerate soil fertility and maintain soil organic matter and humus levels. An exception to this requirement is where soil fertility and structural characteristics are entirely met by importation of composted manures. However the application of such inputs can be limited to 20 t/ha/year.

In addition, there is a preference to include the use of livestock in the rotation cycle, for soil conditioning during fallow periods and for the supply of manures.

Plant health stems from soil health

The underlying principle of organic crop production is that: 'healthy plants grow from healthy soil'. Well balanced, biologically enhanced soil - measured by adequate organic matter, humus level, crumb structure and feeder root development - forms the basis of organic vegetable production. Plants are nourished through a soil ecosystem built over time, and not primarily through fast-acting, soluble fertilisers added to the soil.

Synthetic fertilisers and chemical pesticides and herbicides are not permitted and can be detrimental to biologically active healthy soil.

Conservation and recycling of nutrients is a major feature of any organic farming system. Mineral fertilizers should be used as a supplement to recycling, not as a replacement.



Organic sweet corn

Land degradation problems such as organic matter depletion, soil structure decline, compaction, erosion, and nutrient leaching must be avoided. In general terms, well managed soils with adequate organic matter, biological activity and humus tend to be more resilient against most forms of land degradation.

Biological processes are important

Organic systems are primarily biological systems, both above and below the soil. Pest, disease, and weed control must, in the first instance, encourage and maintain natural biological processes so as to balance disease and pest problems. Enhancement and manipulation of these biological processes forms the basis of organic management. Other control measures and can include:

- choice of species and varieties of crops,
- appropriate rotational program,
- mixed cropping regimes,
- mechanical cultivation,
- mulching and mowing,
- flame weeding,
- biological control and maintenance of beneficial predator habitats,
- mechanical controls such as traps, barriers, light, sound and pheromones.

Where available, the grower should use open-pollinated (non-hybrid) organically grown plant varieties, using seed not treated with synthetic fungicide.

Part certification of a property can aid conversion

Growers may initially convert part of a property to organic methods while continuing to use conventional methods on the remainder. Typically, this involves selecting a location with low risk of spray drift or contamination from adjacent land. Buffer zones may be required to ensure adequate separation from conventional cropping.

Sufficient area must be allocated to develop a functioning organic system and to allow for a sustainable crop rotation to be established. Some organic certifiers may also require a development plan that aims to convert the whole property to an organic system within a defined period. Generally it is not possible to certify just one crop. Moving into and out of organic certification is also unacceptable.

Minimum qualifying period

The transition from a conventional system to a balanced, biologically active organic system is a gradual process. For organic vegetable production the land must be managed in accordance with organic standards for a minimum of three years. However, growers can obtain certification as 'in conversion' to organic after one year (pre-certification) of compliance with organic standards. Markets for 'in conversion' status may require careful assessment, as premiums can be lower than for full 'organic' certification.

Avoid contamination and spray drift

Potential sources of contamination, from spray drift, water sources or other means, can require careful consideration. Buffer zones are likely to be required between organic crops and conventional crops. Neighbours must be informed of contamination risk and co-operation sought. Soil tests may be required to check for chemical residues in soil from previous land use.

Genetic engineering is banned

The use of genetically engineered (GE) organisms and their products are prohibited in any form or at any stage in organic production, processing or handling. Crops and land must be free of GE contamination.

Co-existence with, and protection of the environment

Maintaining biological diversity on and around the farm, is an important feature of organic systems. Avoiding monocultures by encouraging biological diversity tends to allow ecological balance or equilibrium to establish, resulting in a more stable system with less dramatic biological fluctuations - both on the farm and in the surrounding natural environment.

Areas of remnant vegetation should be protected. Shelterbelts and areas of remnant vegetation can be important habitat for natural predators of insect pests, which when kept naturally in check reduce harm to crops and reduce the need for control measures.

Organic farms should also ensure that pollution and other forms of degradation resulting from agricultural practices are avoided. The use of non-renewable resources should also be minimised to help extend availability of these limited resources.

organic

vegetables



Organic bean crop under trickle irrigation

Irrigation management

Irrigation methods must be adequately managed, scheduled and monitored to reduce problems with water table, leaching of nutrients and salinity inducement. Irrigation management must minimise disturbance to the environment and natural ecosystems, including wetlands, river flow regimes and wildlife habitat.

Post harvest, storage and processed products

To prevent contamination of vegetables on farm, organic product must be kept in a dedicated storage area separate from conventional product. Post harvest treatments and packaging materials must comply with organic standards.

Where growers intend to value add or process vegetables, compliance with organic processing standards is required if the final product is to be labelled as certified “Organic”.

Making the change to organic

Setting up an organic system of vegetable production will take time. Organic standards require a minimum of three years, and this reflects the significant changes that must take place for an organic system to begin to function properly. This period will require serious commitment to understanding the different approach involved, especially in relations to the way plants are fed and how to manipulate biological processes – both above and below the ground.

Developing a system of organic vegetable production that suits your situation may not be simple. Expect some crop failures, be prepared to make mistakes and don't expect an organic crop to perform the same as a conventional crop. Sometimes a crop you are familiar with will perform quite differently under an organic system, for example different growth patterns or the impact of pest or disease burden.

Most growers start with a small area that is unlikely to have a significant impact on profit. By starting with a small trial area dedicated to organic methods, growers can gain experience, knowledge and confidence about what works and where problems may occur.

Growers who already use integrated pest and integrated weed management techniques may find the transition to organic less dramatic than otherwise.

Working in conjunction with a few of other growers can speed up the learning period by providing more scope for testing ideas and finding better solutions.

Selecting a Site

Selecting a location isolated from potential sources of pest, disease or weed introductions is obviously desirable but not always possible. Sites that are away from conventional production areas can avoid problems of spray drift and chemical contamination. On windy sites windbreaks may be required, not only to control spray drift problems but also to protect crops from wind effect and damage. Buffer zones between conventional and organic areas can be used to protect against contamination.

Selecting better quality soils is likely to be helpful and require less inputs than poorer soils. For example on the sandy soils of the Swan coastal plain, the red/orange (Spearwood) sands are likely to require relatively less nutrient inputs and lower water demands than other sandy soil types. In addition, the small clay content is likely to assist the development of good soil biological, physical and chemical conditions suitable for organic

production. Chemical or heavy metal residue in soil must not exceed limits set by organic standards.



Shelter belts act as wind breaks and buffer from spraydrift

Water requirements for vegetable production in WA can typically be in the order of 15,000 – 18,000 cubic metres/ha/year. Consideration should be given to possible sources of unacceptable contamination or excessive nutrients in irrigation water.

Organic vegetable production methods

To meet organic certification requirements, conversion from a conventional system to an organic system is likely to involve changes to existing management practices and adoption of some new strategies and techniques. Changes to management go beyond simply not using synthetic chemicals and fertilisers.

This section outlines some of the strategies and methods used by organic vegetable growers that should be considered when planning conversion of existing conventional production systems. Please note that details provided are general outlines only. Specific techniques and strategies adopted by individual organic growers will vary according to their circumstances, location of the property and type of enterprise.

Good organic managers rely on close observation, anticipation and prevention to develop a robust organic system for each situation.

Overall management strategies need to reflect the following key organic farming principles:

- soil health largely determines plant health;
- organic systems are biological systems;
- organic farms should operate as closed systems as far as possible; and
- a holistic approach ensures good integration

Many of the best management practices developed for conventional vegetable production are likely to also be applicable for organic systems. Efficient irrigation management, windbreaks, erosion control, and aspects of integrated pest management or integrated weed management may be adapted to suit an organic production system. In addition, quality control management systems, preferably incorporating a HACCP (Hazard Analysis and Critical Control Point) system - for example the SQF 2000 system, are likely to be beneficial.

As with other forms of organic farming, organic vegetable production requires a whole farm approach. Increased reliance on management, rather than substances, demands careful planning.

A well designed whole farm plan should devote special attention to the conversion phase – the first three years of transition from conventional to organic management - when markets for ‘in conversion’ product may be uncertain and while practical experience is being developed. Such a plan can enable an organic system to be easily integrated with all farm activities. Financial risk can be managed and adoption of each new

operational component can improve management and enterprise effectiveness.

Details of the progressive changes intended will help develop a smooth conversion towards a profitable, productive and sustainable organic system.

The major changes are likely to relate to the following aspects of production:

- rotations
- soil fertility and nutrient inputs
- weed control
- pest and disease control

Rotations

Deciding on a suitable cropping rotation for an organic system is of vital importance. Every crop in the rotation must be grown according to organic methods in order to retain organic certification over the land. Apart from complying with organic standards, the selected rotation must attempt to satisfy a number of criteria such as:

- suit market demand, particularly in terms of seasonal timing and prices.
- make efficient use of machinery, land, water and other inputs.
- provide whole farm year-in year-out profitability.
- minimise pest, disease and weed problems.
- remain sustainable in terms of soil conditions and fertility.
- be practical and relatively simple in terms of day-to-day management.

Organic vegetable production rotations, ideally, are designed to involve different plant types, not only for pest and disease control but also to optimise the use of each soil fertility building phase. As a general concept, such a cycle may begin with a green manure crop or applied compost incorporated into the soil. The soil then has highest fertility, so crops requiring rapid growth or having high nitrogen demand should be grown. Typically, these may be leaf crops such as lettuce or sweet corn with fibrous root systems. The next crop would be a flowering crop with less fertility requirement and different root system, such as broccoli or cauliflower. The third crop would be a fruiting vegetable with more extensive roots, such as tomatoes. The final crop should have the lowest relative fertility requirements, typically these are root vegetables such as carrots. Thus the general cycle - leaf > flower > fruit > root - is considered ideal for optimising the use of soil fertility resources. However, in practice compromise is often required in order to balance practicality with profitability and sustainability.



Cauliflower and green manure rotation

Wherever possible, a green manure crop, leguminous crop or a pasture ley phase should be included. Continuous cropping rotations without a pasture ley or green manure phase are generally not preferred, but may be acceptable only where soil fertility and structural characteristics are entirely met by importation of composted manures. However, the application of such inputs may be limited by some certification organisations to 20t/ha/year and/or the potential capacity of the land to produce such volumes of inputs.

Disease or pest organisms affecting vegetables can survive in crop trash and soil for several years. As wide a rotation as possible should be practiced to minimise the risk of disease build-up.

Acceptable rotations depend on individual circumstance, particularly relating to personal preference, experience and expertise, existing equipment or capital to change equipment, crop suitability to the farm location and risk or reliability of successful crops.

Every crop in the rotation must be grown according to organic methods in order to retain organic certification over the land. Each crop should have a ready organic market if premium prices are to be obtained.

Clearly, there are many reasons not to include a crop in the rotation, however some compromise will need to be made - bearing in mind that the whole farming system year-in year-out profitability must be considered, rather than just individual crop gross margins. For example, growing a green manure crop may not be in itself be profitable, but contributes to the value of subsequent crops in the form of soil fertility, weed control and possibly pest or disease control.

Soil Fertility and Nutrient Inputs

The management of soil conditions and fertility is considered the most fundamental aspect of organic farming systems, and is believed to underlie most other aspects of the production system including pest and disease control.

Optimal management of soil resources in organic farming requires a balance of not only the nutrient status of a soil, but equally importantly, its biological and physical condition. Long term maintenance of soil fertility is a key management objective of sustainable organic vegetable production.

Soil fertility in organic systems is based on nurturing and maintaining soil biological activity. Adequate levels of soil organic matter provide the energy needed for soil biology to perform the essential functions of decomposition, transformation and mineralisation for soil structural development and nutrient availability. Soil chemical imbalance and mineral nutrient deficiency can be corrected by applying permitted nutrient inputs. These generally require microbial mineralisation to become available for plant use.

Developing and maintaining good soil structure is critical to allow plant roots to extend deep into the soil and exploit a large volume of soil for moisture and nutrients.

Conventional growers typically approach plant nutrition from an N, P and K dominant perspective, with additional amendments for minor nutrients. While this approach cannot be ignored, organic growers adopt a different approach to plant nutrition - based on a living soil system.

The primary concept is to feed the soil (biology), and via biological transformations and humus formation plant nutrients are made available in a form that allows plants to selectively assimilate nutrients according to their requirements. This approach is believed to maintain balanced plant growth. Soluble nutrients in the free soil water are avoided, hence the use of highly soluble conventional synthetic fertilizers such as normal bag fertilizer is not permitted.

Soil health relates to an equilibrium or balance between biological, chemical, and physical aspects of soil conditions. Optimising soil nutrient fertility, soil structure and soil biology are the fundamental aims of organic soil management. Maintaining adequate soil organic matter, especially humus, forms the basis of this approach.

organic

vegetables

A combination of management techniques can be used according to soil type. These may include:

- green manuring,
- application of compost,
- legume crops for nitrogen fixation,
- crop rotations,
- biological inoculants,
- approved soil amendments,
- approved nutrient inputs, mineral fertilizers,
- animal use, and
- appropriate cultivation practices and deep rooting plants.

Excessive cultivation, and cultivation implements, which rapidly destroy soil structure or biology, must be avoided.

A **green manure** crop generally consists of a mix of annual plants incorporated into the soil while green to improve soil properties and fertility. A dense, well established green manure crop can add organic matter, improve soil structure, soil fertility and give good weed control.



Oats and lupins green manure ready to plough under

Green manures are an essential component of good soil management and can provide the following benefits:

- Add soil nutrients – especially legumes for nitrogen fixation.
- Conserve nutrients - especially grasses that scavenge nitrogen to be recycled when incorporated and made available for use by the next crop.
- Maintain soil structure – particularly when fibrous root systems permeate the soil. Deep, strong root systems like lupins help break up hard pan and compaction.
- Organic matter maintenance – particularly where repeated cultivation occurs.

- Erosion control – reduces the impact of raindrops and crusting, allows better infiltration and limits surface water run-off.
- Disease control – especially through the use of non-host species to break pest and disease cycles, and the use of biofumigant plants.
- Weed control – can be effective with fast growing species that smother weeds. Weed seed burden is reduced if weed plants are turned in prior to seed set.

The effective use of green manure crops form an integral part of organic management. Green manure crops usually include some legume for nitrogen addition, and can be used to return nutrients and organic matter to the soil. Good growth of a well-inoculated legume based green manure can add 100–200 kg nitrogen per ha to the soil.

A mixed green manure planting combines the benefits of several species and can provide better weed suppression. Factors that determine the suitability of a plant as a green manure include; availability and cost of seed, rate and quantity of top growth, type and size of root system, length of growing season, ability to compete successfully with weeds and ease of incorporation into the soil. A typical mixed green manure crop may include:

- legume species, such as vetch, field peas and lupins for nitrogen build-up,
- grass species, such as rye, barley or oats (Saia oats for nematode control), to improve soil structure, biomass and humus build up.
- brassica species, for biofumigation, such as table mustard.

Grass species, such as cereals, can make legumes more efficient at nitrogen fixation, but can also out-compete legumes if sown too heavily, thereby reducing nitrogen fixation. Careful species selection and management is important to prevent green manure plants from becoming a weed problem. For example, some clovers can become a weed problem. Hard seeded brassicas can create a near permanent source of weeds, but varieties developed as annual soft seeded crops (e.g. table mustard) can minimise this problem.

When incorporating a green manure, shredded material breaks down faster than coarse material and cultivation of the soil will be easier. Relatively shallow incorporation can help maintain good aeration for decomposition and minimise disturbance of deeper roots and related soil structure. Adequate moisture is required for the breakdown of organic matter. Soil microbial inoculants may speed up and improve decomposition.

Compost is the preferred means of supplying nutrients for growing organic vegetables. Compost suitable for organic production must be free from unacceptable contamination. Compost must have correct carbon : nitrogen balance, aeration, water and temperature conditions to undergo proper decomposition and humus formation. Thorough composting of materials kills weed seeds, pests and diseases, reduces odours, degrades chemical residues, removes breeding sites for flies, reduces toxicities and supplies normally mobile nutrients in a stable form which is less subject to leaching. It also reduces the bulk of the material and makes it easier to handle.

The use of compost, particularly on sandy soils commonly used for vegetable production, can provide significant improvements in soil physical, chemical and biological conditions. Good quality compost can increase soil nutrient retention and availability to plants, increase soil water retention, increase beneficial soil biological activity and improve soil structure.

The value of compost must be considered over time and from a number of aspects, including its ability to improve plant nutrient uptake, buffer against water stress, support healthy vigorous growth and suppress plant diseases.

Since materials in compost are in a stable form and their immediate availability can be low to moderate, timing of applications is important and may occur several weeks prior to cropping or during the green manure phase. Generally, compost does not provide a large source of immediately available nutrients, particularly nitrogen, although potassium and to a lesser extent phosphorous availability may be adequate depending on the compost quality.



Large scale commercial compost production

The application of compost can range from 5 - 20t/ha according to soil type and soil conditions. Commercial quantities of compost suitable for vegetable production are now becoming available in various locations. Specific formulations may be required to suit individual conditions. Wet compost can be difficult to spread.

Supplementary nutrients based on demonstrated deficiency can be applied in organic farming. The use of supplementary nutrients is generally restricted to situations where nutritional corrections are not available using a more favourable product or methods. Excessive application of nutrient supplements should be avoided and may be restricted by some certifiers to 15t/ha/yr.

A wide range of allowable products involved with soil fertility is now available. These include:

- composted and formulated manures
- various rock minerals including reactive phosphate rock (RPR)
- blood/meat/bone meal
- fish products
- seaweed products
- microbial preparations
- various vitamins, humates and
- various liquid formulations or teas.

Scientific verification of many of these product claims has yet to be established. As a consequence, the decision to adopt particular products tends to rely on anecdotal information and experience rather than rigorous scientific testing.

Management of soil conditions involves maintenance of optimal soil organic matter levels as well as balancing nutrient levels. Soil testing at regular intervals is important to monitor changes in soil conditions.

Interpretation of soil testing, and management of soil fertility for biological systems, has attracted a number of alternative approaches to understanding soil conditions and plant growth. An outline of several alternative concepts used by organic growers is provided in Appendix 3 for consideration.

Sources of nutrients

Many of the nutrient sources used in organic production are in a less soluble form than conventional fertilizers. Highly active soil biology can play an important role in mineralizing these nutrients into forms suitable for plant uptake.

The acceptability of any nutrient input should be approved by the relevant organic certifying organisation prior to use. A list of permitted nutrient inputs is provided in Appendix 2. Also refer to input suppliers list “Organic Production Input Products and Suppliers” compiled by AGWEST. Input materials should not be used to support a poorly designed or badly managed system.

Nitrogen (N): is the most important plant nutrient for high yield, but is readily leached from most soils and sandy soils in particular.

Acceptable sources include compost, dried blood, and a range of proprietary organic fertiliser brands such as Complete Organic, Organic 2000, Dynamic Lifter, Blood and Bone, Fish emulsion, and other protein sources. A number of these products can have a slower rate of soil mineralisation (plant availability) than many conventional sources of N, so during periods of rapid growth ensure sufficient N is available for balanced growth without causing excessive uptake. Excessive uptake is believed to increase plant susceptibility to pest and disease.



Sweet corn sidedressed with composted poultry manure

Phosphorus (P): For organic production less soluble forms of phosphorus such as reactive phosphate rock (RPR) or guano is used. A biologically treated RPR is also available. A range of formulated organic fertilisers incorporating RPR or guano is permitted for use on a restricted basis. All sources of phosphorus must not contain high levels of cadmium.

The lag time for applied RPR to become available for plant uptake may require application well before cropping. The effectiveness of RPR is enhanced by applying as a fine powder that is well distributed in the soil.

Typically, rock phosphate contains negligible amounts of sulfur (unlike superphosphate) so in sulfur deficient soil a separate source of sulfur may be required.

Potassium (K) sources permitted under organic production include rock dust, basic slag, wood ash, langbeinite (Kmag) and sulfate of potash. Compost may also provide a good supply of K. A range of permitted organic fertiliser blends containing K is available. Soils with high organic matter and humus content can reduce potassium lost through leaching.

Calcium (Ca): Acceptable sources of Ca for organic production include limestone, dolomite and gypsum. Calcium nitrate is not permitted.

Magnesium (Mg): Acceptable sources of Mg include dolomite, KMag and Magnesium sulfate.

The role of calcium and its proportion to magnesium and other cations is considered very important in soil biological processes and nutrient availability by an increasing number of organic growers (*see Albrecht appendix 3*).

Trace element mineral supplements: as with other nutrients these may be applied only to a demonstrated soil deficiency. In general terms naturally occurring sulfates are permitted. Chelated elements are permitted but not EDTA chelates.

Weed management

The use of synthetic herbicides is prohibited under organic certification. Economic weed control remains one of the most important aspects of a successful organic vegetable production system.

Organic growers do not aim for total weed control. In certain situations weeds can be managed to provide beneficial effects, for example; by encouraging beneficial insects, soil fungi, and overall species diversity, and in light soil help reduce nutrient leaching, particularly nitrogen in wet conditions. However, weed management is often the most difficult aspect of organic vegetable production. The aim is a balance between the level of weeds and the growth and yield of the crop.

Like many other aspects of organic production systems, weed control requires an integrated approach. Preparing the land to reduce weed burden prior to cropping is very important to minimise weed problems. Growing vegetables on a weedy site should be avoided.

A combination of weed control measures commonly used can include:

- amendment of soil conditions,
- cover crops and green manure crops,
- crop rotation,
- crop varietal selection,
- biological controls,
- mechanical cultivation, plough, scarifier, hoe, harrows,
- flame and steam weeders,
- smother crops and mulches,
- brush and rotary weeders,
- hand weeding.

Soil conditions are considered by many organic growers to influence problem weeds. Corrections to soil pH, soil nutrient imbalance and soil structure have been reported to affect different weed species and their control.

Previous land use can have a significant impact on weed burden. Designing a **crop rotation** that creates a low weed burden will benefit a subsequent vegetable crop. Weed control can be more difficult in summer sown crops than those sown in winter. Pasture leys when well managed to prevent seed set, or **green manure** crops turned in at the optimal time, can be used to reduce weed burden. Crops such as potatoes can achieve good weed control, but can create a problem of volunteer potato plants as weeds in a following vegetable crop. Brassicas, such as broccoli or cauliflower, may leave a weedy paddock, as can longer term crops such as onions.

Varietal characteristics likely to minimise the impact of weeds may include the following features:

- High yielding – to compensate for weed competition.
- Fast early growth and large tops – to smother weeds.

Weed control methods prior to seeding typically begin with **cultivations** during soil preparation and bed-forming. Allowing a subsequent good weed germination, followed by a final shallow cultivation or **flame weeding** prior to sowing the crop, is very important. Flame weeding this flush of weeds can give effective control without disturbing the soil surface. This approach may reduce further weed germination by minimising the stimulating effect soil disturbance can have on new weed germination. Well-timed pre-emergent flame weeding can considerably lower subsequent weed control cost. After sowing and just prior to crop emergence, a flame weeder can be used again to give a weed free bed. Transplanted crops like cauliflower should be planted immediately after a final flame weed.



Gas powered flameweeding

In non-competitive crops like carrots, the optimal weeding time (after emergence) occurs over a very narrow time period, so post emergence weeding must be carefully timed. For non-competitive crops, yields may be reduced by 5% each day the crop remains weedy outside the optimal weeding time window. Research has shown that vegetable crops can tolerate weeds for much of the time between sowing and harvest, and that a short weed free period, or a single weeding at an optimal time, may be sufficient to prevent yield loss. Weeds have little effect until the onset of competition. However, if the crop remains weedy beyond this critical point, crop yields will suffer. Conversely, weeds that emerge after this optimal weed free period will suffer from crop competition, and so can remain without affecting yield.

Mechanical weed control between rows using a **rotary brush hoe** or rotary scarifier may be used at about the 2-3 week stage and again at the 4-5 week stage depending on weed competition and extent of crop canopy closing over rows.

Timing of weed control is critical for good results. Weed control by mechanical means is more effective on small weeds, early in the day with hot, dry, windy conditions to ensure a good kill with few transplants.

Follow up **hand weeding** is often required to clean out problem weeds, especially within rows. The amount of hand weeding required depends to a large extent on effectiveness of other weed control measures, particularly optimal timing in relation to weed size and weather conditions.

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vegetables

Within row weeds are reported to be the most difficult to control. Smother crops, that emerge with the crop seedlings then die-off, are a possible solution. One grower in Victoria has used cold sensitive clover varieties in this manner with good results.

The use of **mulches and smother crops** is being investigated in California with promising results. Cowpeas as a cover crop, cut at the soil line leaving a mulch over the bed, have been shown to provide season long weed control for transplanted peppers (capsicum). Adaptation of this technique, using fast growing cover crops mulched down between crop rows, may provide adequate weed control with the additional benefits of wind protection, moisture conservation and enhanced soil biological activity. Straw laid thickly along the rows to smother weeds has the same effect. However, ensure that material bought in from non-organic certified sources is free from contaminants and is acceptable to certifying bodies.

Weed mat or black plastic laid along the vegetable rows is highly effective in controlling weeds. Paper or cardboard mulch is also effective. Plastic mulch must be removed after cropping but paper mulch will usually break down before the end of cropping, adding to the organic matter content of the soil.

Biological weed control agents, so called **bioherbicides**, are being developed and are likely to be available in the future. In addition, some plants, for example oil seed rape, are known to release chemicals, which suppress the germination of other plants. Weed suppression by this method may be incorporated into a green manure mix.

Research is also being conducted into the use of various vegetable oils and starch based products for use in weed control. A plant oil based herbicide is available, although not acceptable to all organic certifiers.

Completely weed free crops are unlikely to be achieved in an organic system. However, minimising weed seed set within a crop is important for reducing the weed burden in future crops. Weed control sufficient to allow mechanical harvesting is likely to be required.

Economic control of weeds must be determined on the basis of economic thresholds i.e. deciding what level of weed control expenditure will give optimal return rather than on the visual appeal of a totally weed free crop.



Economic control of weeds

Pest and disease management

Organic standards prohibit the use of synthetic pesticides including insecticides, fungicides, miticides and nematocides and other synthetic chemicals. However, a range of naturally derived products is allowable for use as a last resort where preferred management practices have been exhausted.

As with other aspects of organic vegetable production, pest and disease control requires an integrated approach. Background management measures to prevent pest and disease problems are very important and can include a combination of the following:

- Select a low risk location for potential pest or disease or avoid high risk crops.
- Schedule crop timing to avoid high incidence periods.
- Use resistant varieties.
- Design crop rotations to minimise pest and disease build up.
- Ensure soil conditions (chemical, physical or biological) do not favour pest or disease.
- Develop and maintain natural biological processes that balance pest and disease problems e.g. establish habitat and food source for beneficial organisms. Avoid inputs and treatments that have a negative impact on predator : prey proportions or harm soil beneficial organisms.
- Use mixed cropping regimes, appropriate species and avoid monocultures.
- Maintain balanced, healthy plant growth.
- Use cultural methods to minimise the opportunity for pest and disease outbreak.

In general, organic growers indicate that most of the main pest and disease problems tend to diminish below economic damage thresholds by using combinations of the above preventative measures. Wherever possible, close monitoring of pests and disease and their control agents, should be used to determine the need for additional control measures.

As a last resort, difficult to control pest and disease problems can be treated using a wide and expanding range of allowable products. These treatments can be either target specific or non-target specific products. Non-target specific products are generally avoided, and must be used with due regard to their potential negative impact on beneficial organisms and disrupting other predator / prey (pest) balances.

Target specific products can include:

- pheromone traps,
- mating disrupters,
- biological control agents,
- a range of natural substances - toxins, repellents and antifeedants.

Non-target specific methods can include:

- sticky traps, light traps,
- barriers - natural or manufactured,
- repellent or catch crops - grown around an area,
- vacuum suction,
- solarisation - for soil pathogens,
- a range of natural substances - toxins, repellents and antifeedants.

The acceptability of any pest or disease control products should be approved by the relevant organic certifying organisation prior to use. A range of permitted materials for plant pest and disease control is listed in Appendix 2. Also refer to input suppliers list “Organic Production Input Products and Suppliers” compiled by AGWEST. Input materials should not be used to support a poorly designed or badly managed system.

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vegetables

Possibilities for control of some pests and diseases are shown in the table below. Note that acceptability of the materials should be checked with current standards of your organic certifying organisations.

Disease control

Disease	Crops	Control
<i>Alternaria or black spot</i>	Tomatoes, potatoes	<p>Copper hydroxide - avoid Cu build-up in soil</p> <p>Liming soil to pH > 7.2</p> <p>Deep plough, grow on alkaline soil, rotate 5-10 years. Liming soil to pH>7.2</p> <p>Potassium permanganate seed dressing</p> <p>Resistant varieties where possible</p> <p>Sulphur (may cause damage in hot weather or when applied to cucumbers and rock melons)</p> <p>Deep plough the infected crop</p> <p>Use resistant varieties where possible</p>
<i>Bacterial diseases</i>	Brassicas, tomatoes	
<i>Damping-off</i>	Seedlings	
<i>Stemphylium</i>	Onions	
<i>Pythium (cavity spot)</i>	Carrots	
<i>Downy mildew</i>	Brassicas, onions	
<i>Clubroot</i>	Brassicas	
<i>Damping off</i>	Most vegetables, seedlings	
<i>Fusarium</i>	Many vegetables	
<i>Powdery mildew</i>	Cucurbits	
<i>Sclerotinia</i>	Many vegetables	
<i>Viruses</i>	Some vegetables	
<i>Aphids</i>	<p>These are repelled by reflective (silver or white) polythene mulch. Floating mulches may be investigated. White oil, garlic sprays</p>	
<i>Cabbage moth, cabbage butterfly caterpillars (Brassicas)</i>	<p><i>Bacillus thuringiensis</i> bacteria (i.e. Dipel®, Thuricide®). Natural pyrethroids and derris dust could also be used as a 'back-up', but may harm beneficial insects.</p>	
<i>Other caterpillars</i>	<p>Natural pyrethroids; derris dust.</p>	
<i>Nemtodas (root-knot and sugar beet)</i>	<p>Nematodes (root-knot and sugar beet. Nematicides used by conventional growers are not acceptable for organic growing, which relies on crop rotations, use of non-host green manure crops and enhancing the soil ecological balance. Inclusion of barley in the rotation is said to reduce root knot nematode numbers. Biofumigants such as mustard, <i>Tagetes</i> species of marigolds ploughed in before planting vegetables and neem oil are also used. Solarisation - covering the moistened soil with clear plastic for three to four weeks during hot weather - is also effective. Avoid introducing infested plants to the property and clean all machinery before entering the farm. Choose resistant varieties.</p>	
<i>Slugs, snails Russet mite Two spotted mite</i>	<p>Socusil® Sulphur (spray). Sulphur or lime sulphur sprays, but may be inadequate in certain seasons. An introduced natural predator (<i>Phytoseiulus persimilis</i> mite) occurs in some Perth market gardens and may also be purchased This should be introduced in early spring when levels of two spotted mite are low.</p>	

There are also various home-made or proprietary organic pesticides based on garlic, oils or soaps which are reported to control some insect pests (e.g. garlic for aphids, grubs and Rutherglen bugs and soft soaps for aphids, thrips, mites and whitefly). White oil and canola oil may be added to pesticides, if required, for plants difficult to 'wet'. Oils should not be used in hot weather. Soaps and coconut oil are also permitted. White oil is acceptable for the control of pests such as mites or aphids.

Organic standards and certification

A grower who proposes to establish serious commercial production of organic vegetables should seek organic certification to verify that the product is truly organically grown in accordance with reputable organic standards.

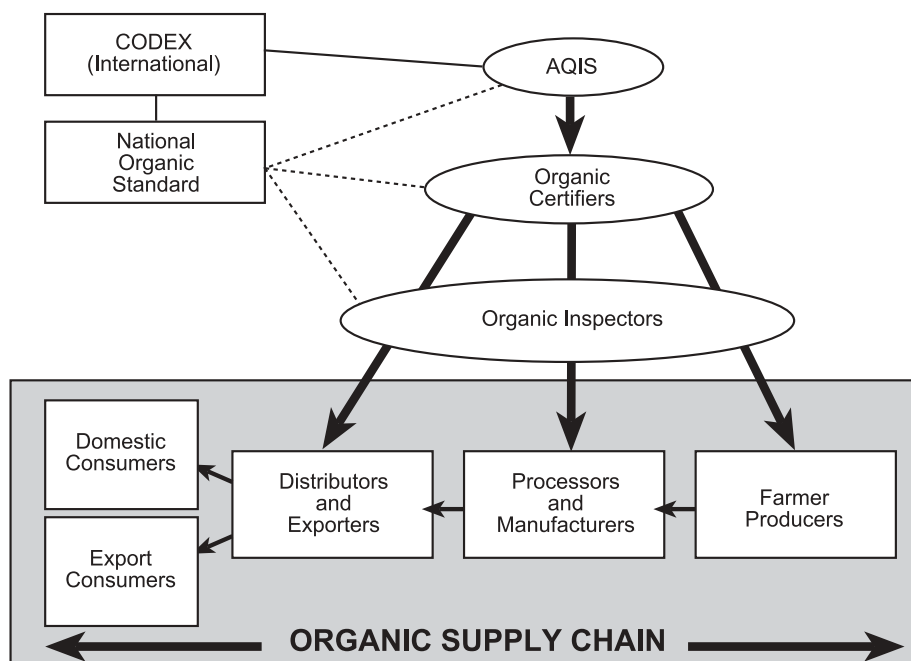
This section describes in general terms the requirements and procedure for gaining organic or biodynamic certification within Australia.

Background - Organic and biodynamic regulations in Australia

Internationally it is accepted that the veracity of claims on the labels of organic products must be underpinned by product and producer certification. The reputation and recognition of the organic certification system is often of great importance to importing countries.

Australia has a well-regulated system for organic and biodynamic production and processing that has gained a good international reputation. The 'National Standards for Organic and Biodynamic Produce', administered by Australian Quarantine Inspection service (AQIS) form the minimum mandatory requirements for export of products labelled as organic or biodynamic. These standards are implemented by seven independent AQIS accredited certification organisations, who conduct whole farming system inspections and ensure a comprehensive record keeping system is in place that allows trace back and verification of inputs used, management practices, yield and sales. Organic standards can also apply to processing and distribution, as shown in Figure 1, to ensure integrity of the certified organic product throughout the supply chain.

Figure 1. Certification Framework of the Australian Organic Industry



(Taken from: Comparison of the Australian National Standard for Organic and Biodynamic Produce with Key International Organic Standards and Regulatory Texts. By Mr May Rod and Dr Andrew Monk. Rural Industries Research and Development Corporation)

On the Australian domestic market no mandatory requirements currently exist regarding the labelling of products as organically grown. However, there is a trend across all markets for objective proof to support claims relating to product attributes. Most reputable retail outlets require independent organic certification by one of the above organisations for product labelled as organically grown.

Organic Production Standards aim to:

- Protect consumers against deception and fraud in the market place and from unsubstantiated product claims;
- Protect producers of organic produce against misrepresentation of other agricultural produce as being organic;
- Harmonise national provisions for the production, certification, identification and labelling of organically and bio-dynamically grown produce;
- Ensure all stages of production, processing and marketing are subject to inspection and meet minimum requirements; and
- Provide a guide to farmers contemplating conversion to organic farming.

Copies of the national standards are available through the certifying organisations, Australian Government Bookshops and the AQIS web site (www.aqis.gov.au).

Contact details of the seven AQIS accredited organic certifiers are listed in Appendix 1.

General requirements for organic certification

The 'National Standards for Organic and Biodynamic Produce' (OPAC 1997) provide a general definition of organic farming as follows:

Definition

“Organic farming means produced in soils of enhanced biological activity, determined by the humus level, crumb structure and feeder root development, such that plants are fed through the soil ecosystem and not primarily through soluble fertilisers added to the soil. Plants grown in organic systems take up nutrients that are released slowly from humus colloids, at a rate governed by warmth. In this system the metabolism of the plant and its ability to assimilate nutrients is not over stressed by excessive uptake of soluble salts in the soil water (such as nitrates).

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.”

Aims

The principle aims of organic agriculture include:

- the production of food of high nutritional value;
- the enhancement of biological cycles in farming systems;
- maintaining and increasing fertility of soils;
- working as far a practicable within a closed system;
- the avoidance of pollution resulting from agriculture;
- minimising the use of non-renewable resources; and
- the coexistence with, and the protection of, the environment.

Features

One essential feature of organic agriculture is the emphasis on biologically healthy, nutritionally balanced soil as the basis for healthy resilient (against pest and disease) plants.

Production avoids the use of synthetic fertilisers, pesticides, growth regulators and other chemical substances detrimental to nature. Genetically modified organisms are prohibited.

In practice, organic certification takes into consideration the whole farming system and typically requires a farm management plan, farm map and record keeping system. The grower must demonstrate and verify that a system is in place and operating in compliance with organic standards. This typically includes a sustainable crop rotation, and strategies to maintain soil fertility, control weeds, pests and disease, as well as water management and buffer zones.

High levels of chemical residues in soil from previous land use can disqualify land from organic certification, as can excessive contamination in plant or animal tissues. Buffer zones and windbreaks can be required to protect certified areas from contamination by adjacent properties. Organic growers should seek cooperation from neighbours who use chemicals on adjacent properties.

Where growers intend to value-add or process vegetables, compliance with organic processing standards is required in order to retain organic certification over the final processed product.

Certification of all production, processing, handling, transport, storage, and sale of organic products is contingent on accurate up-to-date records of the enterprise concerned, to allow scrutiny of the products and processes. Records required typically relate to:

- rotations, soil cultivations and other treatments;
- inputs - type, source, application and timing;
- outputs - production and sales details.

Conversion Period

Provision can exist for part certification where part of a property is converted to an organic system while the remainder is farmed using existing conventional methods. Development plans for converting the entire farm to an organic system within a defined period can be required by some certifiers.

The usual progress towards full organic certification is as follows:

- Year 0-1 = 'pre-certification' (no certification status).
- Year 1-2 = 'in conversion' to organic certified.
- Year 2-3 = 'in conversion' to organic certified.
- After 3 years = full 'organic' certified.

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. A system certified as organic 'in conversion' typically should progress to full 'organic' after a minimum of three years verified compliance with standards.

Penalties may be imposed for failure to comply with organic standards or breach of rules of certification. This may involve cancellation of certification or reversion to an earlier stage in progress towards full organic certification.

How to gain organic certification

Once you have decided that organic or biodynamic production has potential for your enterprise, follow these steps to become a fully certified producer:

- choose an organic or biodynamic certification organisation;
- read the organic standards;
- begin farm conversion;
- apply for certification;
- have farm inspected;
- inspection report submitted; and
- receive organic certification contract

Choose an organic or biodynamic certification organisation

Contact several organic or biodynamic certification organisations (*see Appendix 1*) about becoming a certified producer and choose one based on the verbal and written information gathered, on your enterprise needs and goals, fees involved and market requirements. To find out if there is a preferred or highly recommended certifier, set of standards and requirements (as these can differ – especially between organic

and biodynamic), it may be helpful to contact existing certified producers, organic manufacturers and/or specialist organic retailers or major retailers selling organic products.

Read the organic standards

Read the organic farming or processing standards, which your farm must comply with. Producers must demonstrate a good understanding of organic farming principles and knowledge of practices and inputs permitted as well as those prohibited according to the certifier's organic standards. If there is little or no extension help offered before implementing and establishing changes to your production system, find out if there are any workshops or field days being run, or experienced organic producers willing to show you around their enterprise. Qualified farm consultants may also be available. Have soil samples taken and analysed prior to, during and following conversion to aid farm planning and management.

Begin farm conversion

Changes to the existing production system must be made – either all at once to convert the entire property, or in planned stages. The producer must demonstrate that an appropriate system is being implemented in compliance with the organic standards.

Apply for certification

When changes to the farming system have begun, application for organic certification can be submitted. Upon receipt of an application, the organic certifier will issue a farm questionnaire seeking all relevant details describing the farming system. Information to be provided 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.

Have the farm inspected

A site inspection by an experienced organic farm inspector will follow soon after the questionnaire has been returned to the certifier. The purpose of this inspection is to verify details of the farming system as described in the questionnaire, and to ensure the producer has a good understanding of the principles and methods of organic farming. As well as discussing the farming system, the inspector will view paddocks, crops, livestock, equipment, sheds and storage areas. The producer must also provide evidence of a complete documented audit trail covering all inputs used, output produced and sales details for all organic products. Soil samples or tissue samples may also be taken for testing.

Inspection report submitted

Following the inspection, the inspector compiles a report confirming details of the farming system 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.

Receive organic certification contract

The certifier offers the producer a contract stating which land and crops certification applies to, and any conditions that must be met. Acceptance of the contract and payment of fees allows the producer to market and label relevant product as certified 'in conversion' or 'organic', and use the logo of the certifier on packaging and promotional material.

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

Producers may be subject to random, unannounced onsite inspections as part of obligations certifiers must fulfill to satisfy Australian Quarantine Inspection Service (AQIS) accreditation. Some properties may also be subject to inspection by AQIS representatives as part of the regulation of the certifying bodies.

Further Reading

Organic Agriculture – Introduction. Department of Agriculture
Farmnote No. 138/2000.

Market Prospects: Organic Carrots and other Vegetables.
AGWEST Miscellaneous Publication 30/2000.

Export Market Potential for Clean and Organic Agricultural
Products. Rural Industries Research and Development
Corporation, Publication No. 00/76.

Organic Production System Guidelines: Beef, Wheat, Grapes &
Wine, Oranges, Carrots. Rural Industries Research and
Development Corporation, Publication No. 00/189.

New Organic Farmer. Elliot Coleman 1992

Organic Farming. Nic Lampkin 1990. Farming Press UK.

Acres Australia. – alternative farming newspaper - Various
editions.

Organic Farming: Soils, crops, fruits and vegetables, NSW
Agriculture, Tocal.

The Good Bug Book - beneficial insects and mites commercially
available in Australia for biological pest control.

Appendix 1. Organic industry certification organisations accredited by AQIS as of June 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 QLD 4350

Phone: (07) 4639 3299

Fax: (07) 4639 3755

E-mail: bfa@icr.com.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

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@om.com.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

Tasmanian Organic-Dynamic Producers

8 Lenborough Street

BEAUTY POINT TAS 7270

Phone: (03) 6267 9443

E-mail: plowe@vision.net.au

Organic Food Chain

PO Box 2390

TOOWOOMBA QLD 4350

Phone: (07) 4637 2600

Fax: As above

E-mail: organicfoodchain@hotmail.com

Appendix 2. Input products for use in organic production (From: National Standards for Organic and Biodynamic Produce)

2.1 Materials for use in Soil fertilising and conditioning

Substances	Specific conditions
slurry from certified sources	-
aerobic compost	compost is the conversion of organic materials into humus col-loids
anaerobic compost	-
straw	-
mined carbon-based products such as peat, or coal	-
blood and bone, fish meal, hoof and horn meal, or other waste products from fish or animal processing	-
seaweed or seaweed meal	-
plant and animal derived by-products of the food and textile industries	-
sawdust, bark and wood waste	from untreated sources
basic slag only	only after residue testing for heavy metals
dolomite and lime	from natural sources
gypsum (calcium sulfate)	from natural sources
calcined or rock phosphate and other crushed mineral bearing rocks	excluding those minerals which are more than 20% soluble
phosphoric guano	-
rock potash and sulfate potash	-
wood ash	from untreated sources
sulfur	-
clay, bentonite	-
attapulgite	-
perlite	-
trace elements includes materials such as borax, natural chelates are acceptable, e.g. ligno sulfonates and those using the natural chelating agents such as citric, maleic, tartaric and other di- and tri- acids	not synthetically chelated elements
homeopathic preparations	-
approved microbiological and biological preparations	-
naturally occurring biological organisms (e.g. worms and worm casings)	excluding products derived from genetic modification technology
fish products	-
zeolites	-
vermiculite	-
potassium glauconite	-

2.2 Permitted Materials for Plant Pest and Disease Control

Substances	Specific conditions
<i>Pyrethrum extracted from Chrysanthemum cinerariaefolium</i>	<i>Without piperonyl butoxide</i>
<i>Rotenone extracted from Derris elliptica</i>	-
<i>Quassia extracted from Quassia amara</i>	-
<i>Neem oil and extracts</i>	-
<i>Ryania extracted from Ryania speciosa</i>	-
<i>Propolis</i>	-
<i>Diatomaceous earth</i>	<i>In non-heat treated form</i>
<i>Stone meal</i>	-
<i>Metaldehyde baits</i>	<i>In traps or enclosed from the environment</i>
<i>Baits for fruit fly</i>	<i>Substances as required by statutory regulation and must be fully enclosed within traps</i>
<i>Copper, in forms such as Bordeaux mixture and Burgundy mixture</i>	<i>Hydroxide is the preferred form except for Bordeaux on dormant tissue</i>
<i>Sulphur in a wettable or dry form</i>	-
<i>Sodium silicate (waterglass)</i>	-
<i>Sodium bicarbonate</i>	-
<i>Potassium soap (soft soap)</i>	-
<i>Biological controls</i>	<i>Naturally occurring organisms and approved cultured organisms such as Bacillus thuringiensis</i>
<i>Pheromones</i>	-
<i>Granulose virus preparations</i>	-
<i>Essential oils</i>	-
<i>Vegetable oils</i>	-
<i>Light mineral oils (white oil)</i>	-
<i>Seaweed, seaweed meal, seaweed extracts, sea salts and salty water</i>	-
<i>Homeopathic preparations</i>	-
<i>Natural plant extracts, excluding tobacco, such as garlic extract, etc. and used as a repellent, antifeedant or pest/disease control</i>	<i>Obtained by infusion and made by the farmer without additional concentration</i>
<i>Potassium permanganate</i>	-
<i>Carbon dioxide and nitrogen gas</i>	-
<i>Vinegar</i>	-
<i>Wetting agents</i>	<i>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</i>

Appendix 3. Alternative Approaches to Soil Management

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. Biodynamic farms aim to be closed, self-sufficient units.

- **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% Ca, 20% Mg on sandy soil and 70% Ca, 10% Mg on heavy soil, with 3–5% K, 10-15% H and 2-4% 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 fertilizer performance in terms of energy release and energy exchange. The contention is that fertilizers in themselves did not stimulate plant growth. It is the energy released (electromagnetic influence or paramagnetic energy fields) from these fertilizers that enhanced production.

A distinction is made between fertilizers (nutrients) that produce growth energy i.e. calcium, potash, chlorine, and nitrate nitrogen, to those that produce reproductive (fruiting energy) i.e. ammonium nitrogen, sulfate 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 is believed to reduce susceptibility to pest and disease and that plant sap sugar level (brix) is directly related to plant pest and disease susceptibility.

Various approaches and analyses relating to 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 practical experience.

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Notes
