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Organic wheat : a production guide

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McCoy, S. (2002), *Organic wheat : a production guide*. Department of Agriculture and Food, Western Australia, Perth. Bulletin 4519.

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wheat

a production guide



prepared by **Steven McCoy**

This publication is based on a report "Organic Production System Guidelines" funded by Rural Industries Research and Development Corporation.

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Introduction

Many people believe that organic agriculture systems can only work in high rainfall regions. However, some of Australia's most successful organic farmers are the experienced organic wheatbelt growers who produce cereal, pulse and oilseed crops in different regions and soil types across the country.

Wheat is the major organic cereal crop grown in Australia - predominantly noodle and breadmaking wheats for export markets.

Farming systems developed by modern organic wheat growers can differ significantly in concept, strategies and techniques from those used by conventional growers. Successful conversion to organic requires careful planning and integration of the whole farming system over several years.

In addition, conversion often involves a significant change in management approach to the farm. While conventional growers may be lured by premium prices (typically 20 to 30 per cent) and expanding markets (consumer demand is predicted to outstrip supply for many years), those converting to organic wheat production need to understand, follow and commit to the principles of organic farming.

This shift in management approach is vital to secure and retain organic certification and buyers, as well as loyal and trusting consumers. Many growers report that making this shift in approach can be the most difficult aspect of developing a sound organic system.

The rewards of a commitment to organic production include promotional and marketing advantages over conventional, with opportunities for generic campaigns for both organic food and organic wheat, and for individual and regional organic brand promotions.

A number of organic grower groups have been formed around Australia as growers have found strength in numbers to coordinate supply capacity, develop markets and best practices in production methods, and to help new growers through conversion.

A mixed approach

Most organic farms are mixed operations, incorporating animals into the system as an integral part of the whole farm management. A number of different crops are grown in rotations

designed to minimise pest, disease and weed problems while maintaining sustainable yields.

Creating biological diversity - through the use of different crops and shelterbelts, building soil fertility and retaining remnant vegetation - is important to establish beneficial ecological balances across the farm, encourage natural predators and avoid conditions which favour pests, such as monocultures.

Close attention should be given to planting appropriate varieties and managing soil and other conditions to ensure grain qualities meet buyer specifications and consumer expectations - particularly relating to protein levels and other end use requirements.

About this guide

This is a general outline for conventional producers interested in investing in the production of wheat grown organically in accordance with the Australian 'National Standards for Organic and Biodynamic Produce' and certified by an accredited organic inspection organisation (see Appendix 1).

Much of the material comes from organic or biodynamic wheat producers from New South Wales, Victoria and Western Australia.

While the underlying principles outlined are similar for all organic farms, organic techniques and methods will need to be amended to suit individual farm enterprises, locations and circumstances.

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.

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Market outlook for organic wheat

Markets for organic wheat have fluctuated over the past few years. While markets for higher protein wheat appear quite strong at present, some growers have had difficulty finding organic markets for lower protein wheat.

Some growers aim to have contracts in place before planting crops. However, in a developing market this is not always possible.

Export markets

Australian exports of organic and biodynamic wheat have grown steadily over the past few years, although volumes remain relatively small. The main markets are Japan, Europe and the United States.

Production of medium protein wheat varieties - such as Rosella or Cadoux for noodle making - is well established and continues to expand. Most of this wheat is for Udon noodles destined for Japan. Product is exported from Australia either as wheat, flour, Udon noodle premix or finished retail ready packs of frozen or dried noodles.



Enjoying organic udon noodles

High protein wheat varieties for breadmaking are exported to several northern European countries including the United Kingdom, Holland, Austria, Norway, Sweden, and Switzerland. They are also exported to Japan. Some South East Asian destinations such as Singapore, Malaysia and Hong Kong are emerging as potential markets.

Australian biodynamic durum wheat and flour is exported to Italy for pasta manufacture. Italian manufacturers reportedly consider this product to be of exceptional quality.

Export trading of organic and biodynamic wheat into European markets is reported to be very competitive, with considerable price fluctuations from year to year based on seasonal supply factors. Exporting to Europe can be difficult following seasons when European organic wheat producers have good crops.

The main competitive suppliers onto world organic wheat markets are the United States, Canada, Argentina and several European countries.

Strong growth within the processed food sector of the organic food industry suggests that there are considerable opportunities for value-adding. Wheat-based products such as breakfast cereals, biscuits, pies, cakes, pastries and ingredient products may all have export potential.

Australian Markets

Australian supermarkets are showing renewed interest in offering a range of organic products. For example, three brands of organic wheat breakfast cereal biscuit are now made in Australia. This development follows mainstream supermarket trends in the major organic export markets such as the United Kingdom, where major food retailers consider organic products to be an 'image asset' in line with consumer demand.

Import replacement presents an opportunity as many organic wheat pasta and noodle products sold in major supermarkets, in healthfood shops and specialty organic stores come from countries such as the United States.

An Australian success story

Weston Milling is a major Australian company actively interested in developing organic wheat markets. Export markets account for 85 per cent of organic sales, which are predominantly to Japan and more affluent South East Asian countries.

The following table shows organic sales for *Weston Milling* for 1998-99.

Product	Amount (tonnes)	Wheat quality
Organic 1 kg packet flour sales (domestic)	1000	ASW/APW
Organic bread mix (domestic)	500	APW/AH1
Organic bread mix (export)	2000	APW/AH1/PH
Organic noodle mix (export)	3000 (WA)	Noodle varieties
Organic noodle varieties (export)	3000 (NSW)	Noodle varieties
Organic durum (export)	1000 (Qld)	Durum
TOTAL	10,500	

(From: Opportunities in Organics, 1999, Agriculture Victoria.)

Weston Milling reports that sales have been growing by 10 per cent, or 1000 tonnes of wheat, per annum. Opportunities have been available to push this growth faster based on current demand, but guarantee of supply and continuity are considered more important in the development of a long term sustainable organic market.

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.



Premium organic markets demand high quality

The United Kingdom Example

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 instore (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 wheat growers added value to their enterprise by developing own brand breakfast cereals, cereal bars, biscuits 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 of organic wheat production

Organic farming aims to produce food of high nutritional value and healthy, quality crops and animals while enhancing and protecting the farm's natural assets. These include fertile, mineral and micro-organism-rich 'living' soils which are the foundation of organic production.

Organic farms work within a closed system as far as is practical, avoid pollution resulting from agriculture, and minimise the use of non-renewable resources. Plant and animal health stems from naturally built-up soil health and good management rather than reliance on synthetic inputs.

This section outlines these and other important underlying principles, practical implications and constraints in planning, converting to and developing a successful organic wheat production system. Aspects of organic certification standards specific to wheat production are included.

A whole farm approach

Growing organic wheat must be seen as only one component of a whole farm system. Continuous wheat cropping, or short rotations with another crop and no pasture phase, are unlikely to be acceptable as a sustainable organic farming system. Therefore, organic wheat production will also involve growing other organic cereal, pulse or oil seed crops in rotation with wheat. Soil-regenerating pasture phases will also be included. Rotating or inter-planting crops with different growth habits, and using crop varieties suited to specific land types can add diversity to the whole farm and favour the establishment of a more balanced ecology which prevent conditions favouring pests and disease.



A whole farm approach is used to optimise management

Enterprises aim towards mixed, closed systems

As with all organic farming enterprises, organic wheat production should aim to operate within a closed system with all inputs ideally produced on-farm, and renewable resources used wherever possible.

To achieve this, organic farms are typically mixed enterprises with a balance of crops, pasture and livestock. Animals on the farm such as sheep or cattle can help to build and maintain soil fertility, promote carbon cycling, manage pastures, control weeds and diversify the farm's biology.

Animals run on organic land should ideally only be treated with permissible organic inputs. Animals given chemical treatments require a quarantine period before release onto organic land, and may never be certified or sold as organic.

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 wheat 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 active healthy soil.

Well managed soils with adequate organic matter and biological activity tend to be more resilient against land degradation. Problems such as organic matter depletion, soil structure decline, compaction, erosion, and acidification are avoided through good management. Soil problems related to water imbalance, such as waterlogging and salinity are reduced or require specific remedial action.

Part certification can aid conversion

Growers typically convert part of a property to organic methods while continuing to use (modified) conventional methods on the remainder. However, to establish a functioning organic system, sufficient paddocks must be converted to organic methods to establish a feasible crop rotation. One paddock is insufficient and it is not generally possible to certify just one crop. Moving into and out of organic certification is also unacceptable. Development plans may be required to indicate intention to achieve whole farm organic certification within a defined period.

Avoid contamination and spray drift

Potential sources of chemical contamination from spray drift or other means should be identified and any possible incidents prevented. Buffer zones are likely to be required between organic wheat crops and conventional crops. Neighbours must be informed of the change to an organic system and their cooperation sought to avoid contamination risks. Soil tests may be required to check for chemical residues in soil from previous land use.

Genetic engineering is banned

The use of genetically modified organisms (GMO's) 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 GMO contamination.

Minimum qualifying period

The transition from a conventional system to a balanced, biologically active organic system is a gradual process. For organic wheat 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.

Coexisting with, and protecting the environment

Maintaining biological diversity on and around the farm is an important feature of organic systems. Avoiding monocultures - where conditions can easily favour pests - by encouraging diversity tends to encourage ecological balance with less dramatic biological fluctuations.

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.



Fencing degraded land

Storage and processed products

To prevent contamination of grain on-farm, clean down procedures may be required for contractors' equipment such as harvesters, trucks and storage silos. Sealed steel silos gassed with CO₂ is the most common method of grain storage.

Where growers intend to value add by processing wheat into flour, premix or a finished product, compliance with organic processing standards is required if the final product is to be labelled certified organic.

Production strategies and methods

To meet organic certification requirements, conventional wheat production must undergo a number of modifications. Changes to management go beyond simply not using synthetic chemicals and fertilisers.

Wheat production using conventional methods tends to rely upon the use of external inputs in the form of artificial fertilisers and synthetic herbicides, pesticides and fungicides to achieve acceptable productivity. In contrast organic wheat production attempts to farm within a closed system relying more on management techniques, biological processes and renewable resources to maintain acceptable productivity.

The thought of producing a crop of wheat without the use of herbicides or fertilisers often seems completely unrealistic to conventional growers. Many organic growers can confirm the difficulty they had in convincing themselves to put in a wheat crop without the use of conventional inputs. Yet over time most organic growers establish a production system that allows them to produce reliable crops of organic wheat with acceptable yields as part of their whole farming system.



Robust organic systems develop over time

This section outlines some of the strategies and methods used by organic wheat 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

The major changes conventional farmers may need to consider when converting to an organic wheat production system relate to:

- whole farm planning;
- rotations;
- soil fertility and nutrient inputs;
- animals;
- weed management; and
- pest and disease control.

Whole farm planning

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

Details of the progressive changes intended to management of soils, weeds, pests, disease, other crops and animals are not considered in isolation, but rather as interrelated aspects of the whole farm, where each decision can benefit or harm other management strategies. This approach will help develop a smooth conversion towards a profitable, productive and sustainable organic system.

Whole farm planning can involve the physical layout and resources of the property as well as the management system to be used. For example, weed control to prepare a paddock for cropping may require intensive grazing pressure. Effective grazing pressure may not be possible on large paddocks.

Additional fencing, realignment, or electric fencing, may be required. Realignment can be designed to follow soil types, thereby improving land use. Smaller paddocks may allow rotational grazing which can be used to control parasites and improve pasture use and soil structure. With whole farm planning, a weed control strategy may also be designed to

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improve pasture use, parasite control, soil structure and land use.

Other aspects of whole farm planning can involve water management and the use of contour banks to direct or store surface water. A comprehensive whole farm plan which projects five to 10 years into the future is an important first step towards establishing an organic wheat production system.

Aspects for consideration during whole farm planning can include:

- enterprise activities;
- financial projections, especially during conversion period;
- organic conversion progression plans;
- farm layout and fencing;
- water management plans and contour tillage;
- shelter belts, biodiversity and remnant vegetation protection;
- cropping rotational plans;
- capital equipment changes; and
- integration of operations and strategic alliances.

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.

Many successful organic farms adopt a gradual property conversion approach as a risk management strategy. As experience and management expertise develops, more of the property can be converted to an organic system.

Strategic alliances with other organic growers, processors or traders can be very important in defining enterprise mix, production levels and delivery dates.

Rotations

A well designed crop rotational system is critical to the success of organic wheat production, and can diversify income sources. Good crop rotations can serve many functions, including:

- maintenance of soil condition (physical, chemical and biological);
- weed, pest and disease control;

- management of soil moisture levels; and
- pasture improvement.



Well designed rotations are critical

Organic standards may limit crop rotation to crops of the same species, family or characteristics being planted no more than two years out of five in a given paddock. The rotation should include (at least) a 12 month ley pasture phase which contains at least one legume species.

Actual rotations used by organic growers vary from farm to farm. Growers may typically crop on average about one third of the property each season depending on seasonal conditions, soil conditions, weed burden, markets and other considerations.

The simplest rotation for wheat production often follows the cycle of:

- pasture>pasture>**wheat**>pasture> pasture>**wheat**.

Depending on soil condition, two or more crops may be occasionally grown in succession following the pasture phase, giving a rotation as follows:

- pasture>pasture>**wheat**>**barley**> pasture>pasture; or pasture>pasture (green manure)>**wheat**>**oats**> pasture>pasture; or, a more complex rotation may be:
- pasture (vetch or medic hay)>pasture>**wheat**> **chickpeas**>fallow>**wheat**.

The pasture phase may need to be longer on light soil where rebuilding soil fertility can be slower. Some growers observe pasture species as an indicator of soil fertility conditions. Declining legumes in pasture and a build-up of grasses is believed to reflect increased nitrogen levels. Some growers aim to turn in a pasture as a green manure at least once every five to seven years.

Growers can remain very flexible in deciding which rotational crops (in addition to wheat) will be planted, with the final decision based on markets, seasonal conditions, soil or land suitability and other circumstances. Flexibility in cropping ability allows growers to take advantage of opportunities when they arise.

Soil fertility and nutrient inputs

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 wheat production. Soil fertility in organic systems is based on nurturing and maintaining active soil biological activity during the growing season.

Adequate levels of soil organic matter provide the energy (fuel) 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.

Soil fertility status typically follows a cycle of progressive improvement during a pasture phase, then decline at cropping. Sustainable organic management requires the improvement phase to at least sufficiently raise fertility for the next crop so that over time the average fertility does not decline.

Methods used by organic growers to maintain soil fertility include:

- crop rotation;
- pasture phases with legume species;
- rotational grazing;
- pasture topping;
- green manuring;
- deep ripping;
- minimal cultivation;
- biological inoculation;
- soil amendments; and
- nutrient inputs.

Crop rotations

Crop rotations which involve a pasture ley phase are used to allow soil to recover lost fertility from previous cropping activities, regain organic matter levels and reverse soil structure decline. A well planned crop rotation may also involve successive crops that have different root structure and nutrient requirements, thereby exploiting soil resources still remaining after the first crop.

A strong legume-based pasture is usually very important to rebuild soil nitrogen levels. The use of legume crops in the rotation such as lupins, field peas, faba beans or chickpeas can also be useful in managing soil fertility, particularly nitrogen levels.

Pasture phase

Under-sowing a wheat crop with a legume can be used to give the pasture phase a head start to establish a good nitrogen-fixing pasture the following year. Excessive shading of the under-sown species can be a problem with some wheat varieties, but establishment can be good under oats, triticale or barley.

Alternatively, a mixed sowing of clovers, oats and other feed species after cropping can provide quality feed while establishing a good clover-based pasture for following years. Some growers report that clover stands last only two to three years before grasses begin to dominate, indicating sufficient soil nitrogen build-up for crop production.



Strong legume based pasture builds soil fertility

Grazing

Animal grazing can be used to manage pasture development. Controlling grasses is important to allow less vigorous and low-growing legumes to dominate. Well controlled grazing events can stimulate fresh pasture growth and root development, increasing soil organic matter and soil structure. Animal manure can improve soil fertility and maintains the natural cycling of carbon and nutrients.

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Pasture topping and green manuring

Mechanical pasture topping (mowing) is primarily used for weed control. However, green pasture cut while soils remain moist enough to support biological activity can be decomposed rapidly to add organic matter, nitrogen and other nutrients to the soil.

Ploughing in a pasture or cover crop as a green manure is another important method of improving soil organic matter and nutrient status. Green manure crops can include a range of species designed to perform specific functions such as legumes for nitrogen fixation, grasses for biomass (organic matter) accumulation and mustard for biofumigation.

Late germinating weeds such as radish, wireweed and capeweed can be ploughed in towards the end of winter. Over-sowing at the same time with oats or barley can protect the soil from summer exposure and prevent wind or water erosion.

Two principal green manure crops used by some growers in summer rainfall areas are fenugreek in winter and celera mung beans in summer. The fast-growing fenugreek is reported to yield 95 kg per ha of nitrogen when ploughed back into the soil.

Cultivation

Soil cultivation requires extremely careful management. Disturbing the soil, either with a disc plough, scarifier, harrows or even a deep ripper, can have a dramatic stimulating effect on soil biological activity. The resulting flush of activity consumes soil organic matter as its main source of energy and repeated cultivation or soil disturbance can rapidly deplete soil organic matter levels resulting in biological decline, nutrient depletion and poor soil structure. Excessive cultivation can also physically destroy soil structure, particularly if soil conditions are too wet or cultivation speed is too fast.

Wherever possible, especially on sites prone to water erosion, cultivation should follow the contour - preferably in conjunction with appropriate contour banks.

Deep ripping

The formation of hard pans below plough depth is a common problem in conventional wheat production. Hard pans restrict plant root depth and the volume of soil that plant roots can exploit.

Organic growers cannot use highly soluble fertilisers that are necessary to compensate for a small root mass exploiting a small volume of soil.

Deep ripping at progressively deeper settings, in accordance with the depth of soil biological development, can be used to remedy hard pan problems and increase the depth of biological activity and soil structure. Applying gypsum in conjunction with deep ripping can assist soil structure development, particularly where deflocculated clays are a problem.

Balanced soil chemistry

Organic wheat producers need to have a good understanding of their soil's chemical condition and remedies that may need to be applied. Soil tests are used to monitor changes to soil chemistry and confirm suspected imbalances.

Many Australian soils may be naturally deficient in major elements or trace elements - particularly copper, zinc, manganese and molybdenum. Apart from consideration of the major nutrients, nitrogen, phosphorous and potassium, the elements calcium and magnesium are often given great importance for their influence on nutrient availability and soil biological activity.

Soil tests can be important to monitor soil fertility balance over time and assess any corrective amendments required. A range of different approaches to soil analysis have gained prominence among organic growers. These include interpretations based on Dr William Albrecht, Dr Carey Reams and Dr Rudolf Steiner - see Appendix 3 for a brief overview.

Nutrient inputs

A wide range of approved soil input materials are now available for use by organic wheat growers. Various naturally occurring soil amendments commonly used by conventional farmers such as lime, dolomite, gypsum and other minerals can also help to balance deficient soils. In addition, a number of biological preparations can be used to inoculate soils with beneficial soil organisms.

Various sources of major nutrients (such as formulations containing acceptable forms of reactive phosphate rock, potassium, magnesium and trace elements) can be used where a demonstrated deficiency exists. Other inputs can include fish emulsion, rock dust, seaweed and humate type organic fertilisers. However, organic standards do not permit reliance on large quantities of applied nutrients to compensate for a poorly managed soil fertility system.

Total nutrient removed for every 2 tonnes per ha of wheat are approximately as follows:

- 42 kg nitrogen;
- 9 kg phosphorus;
- 10 kg potassium; and
- 2.5 kg sulfur.

Nitrogen and organic matter

Organic farms mainly rely on legume nitrogen fixation as their main nitrogen (N) input. Maximising N fixation in legumes and minimising losses through leaching is crucial.

Most nitrogen in the soil is in organic form, which is not available to the plant until it is mineralised to produce inorganic forms of N - ammonium and nitrate. Organic matter varies in its N content and its ease of mineralisation. Recent crop or pasture residues are readily mineralised, whereas older more stable organic matter is mineralised slowly.

Mineralisation continues throughout the growing season at a rate that varies with temperature and soil moisture. Soil cultivation stimulates N mineralisation.

The N released from five per cent of soil organic matter can provide about 110 kg per ha of nitrogen.

Organic production prohibits the use of conventional sources of applied N such as urea, ammonium nitrate or Agran, ammonium sulphate, Agras No. 1, Agras No. 2 and Di-ammonium phosphate or DAP.

Organic growers do not generally apply additional N fertiliser. Instead they rely on sufficient build-up of soil N through the use of pasture legumes, organic matter accumulation and, to a lesser extent, legume crops.

Several years of pasture with a strong base of N-fixing legume pasture species - such as clovers, medics, serradella or lucerne - is the main method of sufficiently raising soil N levels for successful wheat production. Ploughing in a legume-based green manure crop can contribute significant amounts of soil N.

Nitrogen accumulation is greatest in soils with initially low nitrate levels. As soils become more fertile, N increase progressively declines. Some growers report that as soil N levels increase, grass species begin to dominate the pasture, indicating that the paddock is ready for cropping again.

A range of N sources permitted for organic systems are listed in Appendix 2.

Phosphorous

Phosphorous (P) supply and plant availability are very important in early plant growth. A deficiency reduces head and grain numbers, which are established early in the crop.

The movement of P tends to be fairly limited within the soil (although it can leach through sandy soil), so plant uptake generally requires root growth to intercept pockets of available P. Improvements to soil structure that allow greater penetration of root mass through larger volumes of soil may assist P uptake.

Phosphorous levels and availability are considered important issues for many growers, particularly on alkaline soils where P release from rock phosphate can be very slow (resulting in yield declines and poor stands of legumes).

Many organic growers have reported not applying additional P to paddocks for a number of years. In the short term, P availability to plants may come from residual soil P from past superphosphate applications. Some of this P is mineralised by improved soil biological activity and extracted by a larger root mass resulting from improved soil structure.

In the longer term, many organic growers expect that applications of some form of phosphorous may be required to maintain soil P levels. In contrast, a few growers contend that P levels will be naturally maintained through a process known as 'transmutation of elements' whereby certain elements change into other elements. However, research suggests that P levels on organic land tend to decline without addition of some P source.

Application of soluble P fertilisers such as superphosphate or DAP is not permitted in organic production. However, less soluble forms of phosphorus such as reactive phosphate rock (RPR) or guano can be applied before planting.

The role of soil biological activity is particularly important in mineralising this phosphorus to plant available forms retained in the soil biomass. The effectiveness of RPR is enhanced by applying it as a fine powder well distributed in the soil. The longer time for applied RPR to become available for plant uptake may require application well before cropping.

A range of formulated organic fertilisers, incorporating various forms of naturally occurring P such as RPR, apatite, and guano

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are permitted for use on a restricted basis. These fertilisers have differing levels of P solubility. However, other soil conditions such as pH and iron or aluminium binding can also affect P release to plants.

Any source of phosphorous used in organic production must not contain high levels of cadmium. Rock phosphate contains negligible amounts of sulfur (unlike superphosphate), so in sulfur-deficient soil a separate source of sulfur, such as gypsum, may be required.

Potassium

Potassium leaches easily through sandy soils. On soils with high organic matter and humus content, less potassium may be lost through leaching. Sources of potassium permitted under organic production include rock dust, basic slag, wood ash, sulphate of potash and langbeinite.

Calcium

Conventional growers often satisfy calcium requirements by using superphosphate (which contains about 20 per cent calcium) or lime. Calcium can be applied to raise soil pH in organic production. Acceptable sources are limestone, dolomite and gypsum. Builder's lime (quick lime) and calcium nitrate are not permitted.

The role of calcium, and its proportion to magnesium and other cations, is considered very important for soil biological processes and nutrient availability by an increasing number of organic growers. These claims are generally based on Albrecht principles of plant nutrition (see Appendix 3), where the ratio of major cations on sandy soils should be 60 per cent calcium to 20 per cent magnesium, or on heavy soils 70 per cent to 10 per cent respectively.

Trace elements

Soils used for wheat production in Australia can be naturally deficient in a number of important trace elements - particularly copper, zinc, manganese and molybdenum. Deficiencies can be corrected using a trace element mix with permitted forms of the elements such as copper sulphate or zinc oxide. EDTA chelated elements are not permitted.

Animals

The role of animals is fundamental in a sustainable organic farming system. For wheat production, livestock (usually sheep) are commonly viewed as a vital part of the management system. Animals are typically integrated into the whole farming system

as an enterprise in their own right, and are also used as an important management tool for soil fertility building, pasture management and weed control. Animals are also considered to have an important function in energy, carbon and nutrient cycling, particularly during the dry season when soil biological activity is dormant.

Animal grazing is managed by some growers using a high intensity, short duration rotational grazing strategy based on reduced paddock size. Close management of grazing pressure can give good weed control at critical periods when preparing a paddock for cropping.

Weed management

Weed control without herbicides often seems an impossible achievement to conventional growers. However, organic wheat growers can successfully control weeds by means of an integrated approach over several years, involving some of the following strategies:

- soil improvement;
- crop rotation;
- pasture topping and haymaking;
- green manure;
- animal grazing;
- flame or steam;
- cultivation;
- varieties and seeding rates; and
- harrows.

Soil improvement is often cited as one of the most important influences on weed problems. The spectrum of weeds is reported to change as soil conditions change. Where problem soils exist, not only can weeds flourish, but preferred pasture species or crops often do poorly, unable to compete with weed growth. Specific weeds are reported to be indicators of certain soil conditions.

For example, capeweed problems are often associated with acid soils; onion grass can be found on hard tight soil; and sea barley grass may indicate slightly saline soil. Another belief is that soils low in a certain element attract weeds that accumulate the deficient element. For example, legumes may do better than grasses in low nitrogen soils but as levels rise, grasses tend to dominate.

Typical soil improvements include the use of amendments such as lime to adjust soil pH, and gypsum to assist soil structural improvement with resulting impact on pasture composition.

A pasture phase in the **rotation plan** for a paddock provides various opportunities for weed control activities before cropping. Improving pasture species, by under-sowing crops or pasture seeding after cropping, can compete with weeds or change the dominance of certain problem weeds. In addition, certain crops may provide a beneficial impact on control of certain weeds in the following crop. For example, barley or canola can suppress weeds.

Pasture topping with a mower can prevent seed formation and reduce the build-up of weed seeds in soil. Pasture topping becomes useful when excess pasture growth cannot be controlled by grazing or used for haymaking.

One grower reports that **cutting hay** is the most effective weed control. If a pasture is a good clean stand of legumes, then many cropping options are possible. However, if there are a lot of grasses in a pasture, hay is cut to get control of the weeds again. Cutting hay ensures that no weed seed is set that year, so the most weed-susceptible crop is sown following hay as the starting point in a rotation.



Cutting hay can prevent weed seed set

Green manure crops are ploughed into the soil just prior to flowering to prevent seed formation. Subsequent new weed germination is typically late in the season when soil conditions are drying and growth can be more easily controlled with grazing.

Animal grazing can play an integral part in weed control. Controlled grazing pressure can be used to manage pasture species dominance before cropping. For example, low-growing clovers give better coverage when taller growing species are grazed down. Animals can be used to graze down pastures before flowering to reduce weed seed set.

Several seasons of **good grazing management** can reduce weed burdens. If a paddock is to go into cropping next season, heavy grazing pressure can be applied to clean out weeds, leaving the paddock with just enough cover to protect the soil from erosion.

Hand pulling and flame weeders are used for small patches or spot weed control to prevent weed spread. **Thermal weed control** methods are being investigated as a possible alternative for broadacre application. Gas-powered flame systems may provide economical control. However, such systems are still being developed.

Soil cultivation must be kept to a minimum and is one of the last weed control methods used after the above weed prevention and reduction strategies have been applied. The number and frequency of cultivations can have a direct and immediate impact on reducing gains in soil organic matter, nutrient status and soil structure.

Weed growth from summer rains may be controlled using wide point scarifiers if fallowing to conserve moisture is required. Disc plough **cultivation** is often used to 'work up' land following opening rains to kill first germination. The second germination is killed by the cultivation involved with seeding. A well managed weed control system may only require two cultivations. However, timing is critical for effective weed kill. Small young weeds are easiest to kill and sunny, windy days when disturbed roots and soils dry quickly give best results.

Additional cultivation may be required where weed control is poor - but at the expense of deteriorating soil fertility. Prickle harrows have been used within a young wheat crop where post-emergent weeds are an economic problem.

Another alternative used is to run sheep within a young crop to clean out weeds such as wild radish. This is also reported to enhance stooling. Higher density planting and grazing just before tillering, to prevent crop plants being pulled from the soil, are considered important factors. Close management of grazing pressure and careful timing are required for good results.

Selection of suitable **wheat varieties** can also assist in reducing the impact of weeds. Fast-growing varieties that have an early spreading habit may help out-compete weed growth. The main factors appear to be differences in shoot and root growth, and crop ground cover. South Australian trials showed Halberd and Excalibur did best, and in Western Australia, Gutha

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and Eradu were most effective.

Choosing a competitive variety is most likely to be useful when combined with other techniques such as increased crop density and delayed sowing to reduce early weed competition. Short season varieties may be useful if weed management requires late planting.

Seeding rate may need to be increased for organic production to ensure good early coverage. Organically grown wheat can exhibit slightly slower early growth rates than conventionally grown wheat.

If prickle harrows are to be used over a young crop, higher seeding rates may be required to compensate for harrow losses. Seeding rates as high as 150-200 plants per square metre have been shown (in conventional crops) to be about the upper limit before yield declines.

One grower reported using seeding rates at twice the district average, with narrow tine spacing and the seeding boot modified with deflector plates to spread the seed across the furrow. The aim was to get an even spread of seed across the paddock and help out-compete weeds.

Preventative removal of weed seeds at harvest will also successfully reduce weed populations in future years. A range of **bioherbicides** involving fungi, bacteria and other micro-organisms are being developed as a means of controlling weed plants.

Overall, **weed control** in organic production requires long term management, based on an integrated approach using a range of strategies and techniques. Good timing of operations is critical for effectiveness. Cultivation to control weeds depletes soil fertility and should be kept to a minimum. The aim is not to achieve a completely weed-free wheat crop, but instead to manage weeds within an economic threshold.

Pest and disease control

Many growers report few pest or disease problems in organic wheat production. Common pests and disease may be found in organic wheat crops, but at levels that generally do not concern growers and that do not warrant expenditure on specific treatment.

This may derive from a number of management strategies that combine to contribute to the prevention of pest and disease problems:

- resistant varieties;
- soil fertility balance;
- crop rotation and bio-fumigant crops;
- ecological cycles and beneficial predators; and
- biological control agents and other acceptable substances.

Resistant varieties

Wheat varieties known to be resistant to pest or disease problems are an obvious first choice as a preventative measure. The susceptibility or resistance of different wheat varieties is generally well known when grown under conventional farming systems, but their performance has not been well studied under organic farming systems.

Soil fertility balance

The effect of soil conditions on plant growth is considered a crucial factor in plant susceptibility or resilience to pest and disease attack. Poor plant growth or imbalanced growth (due to soil conditions) can make plants less resilient and more susceptible to pest and disease attack.

In addition, soil with good biological activity can provide a level of biological control over soil-borne pests or disease. The organic farmer's dictum: 'healthy soil produces healthy plants' may explain why organic wheat growers tend to report very few serious pest or disease problems.

Crop rotation

Crop rotation is used by organic growers to break disease cycles. Certain crops or green manure species known to suppress target pests or disease can be included in the rotation. For example, brassica crops such as canola can decrease the severity of some wheat diseases like Take-all.

Pasture management to control tall grass species and encourage legumes can also reduce some pests and diseases of wheat. For example, cut worm problems can be more severe with excessive pasture residue before cropping.

Ecological cycles and beneficial predators

The avoidance of herbicides, pesticides and some fertilisers may also contribute to biological diversity and better ecological balance of pests and diseases. Understanding the life cycles of specific pests or diseases, as well as their place in the general ecological cycles of the farm and surrounding district, is essential knowledge when considering control measures.

Organic farms typically become biologically diverse, allowing a range of natural biological control cycles to develop and maintain many pests or diseases at acceptably low levels.

Biological diversity can be enhanced by use of shelterbelts, mixed species in pastures (including attractant species) and maintaining habitats for beneficial populations to persist. The non-use of pesticides, particularly wide spectrum substances which kill a range of non-target creatures, also enhances biodiversity and allows beneficial insects, spiders and other creatures to proliferate.

Biological control

Outbreaks of major pest or disease problems usually indicate an imbalance exists and efforts should be made to correct the imbalance. However, an increasing range of biological control agents and other acceptable substances are being developed that may be applied where preventative strategies fail to provide economic control.

For example, red-legged earth mites (RLEM) can be a problem in leguminous pastures. Predatory mites are available and can be introduced - although their rate of spread is slow so introductions may be needed over a wide area. Applying lime to raise the pH in acid soil is reported to reduce RLEM severity. Neem oil-based product with pyrethrum has been reported to control RLEM in horticultural situations, however growers must ensure that products are registered for use.

Pasture management

Cutworm damage is reported to be related to pasture management problems. Excessive grass pasture coverage before cropping is believed to benefit the pest, causing a more severe problem in the following cropping year. Close management of pasture grasses prior to cropping can minimise cutworm problems.

The major wheat leaf diseases including *Septoria nodorum* blotch, yellow spot and *Septoria tritici* blotch typically cause few problems for organic growers. Sound rotations, later sowing and less luxurious plant growth may account for the low impact of the diseases. Similarly the reported low incidence of take-all root disease may be due to long rotations and good host grass management in pastures.

Preventative measures for control of cereal rusts such as stripe rust, leaf rust and stem rust include:

- good pasture management and close grazing to minimise host plants providing a 'green bridge' to carry the fungus over summer;
- use of resistant varieties especially following wet summers and high carry-over of fungal spores; and
- avoidance of early sown crops which can carry rust through winter allowing rapid development in spring.

Grain storage

On-farm grain storage may need to be considered, particularly as organic grain is often sold outside of the storage and distribution systems used for conventional grain, and separate storage for organic grain may not be available. The preferred method of storage is in sealed silos gassed with carbon dioxide.



Sealed silos gassed with CO²

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An example of an organic wheat production system

This section gives a general example of an organic wheat production system. Variations should be developed to suit individual farm conditions and circumstances.

Preparing the land

Establishing *soil conditions* with balanced nutrients, adequate organic matter, extensive biological activity and good deep structure is the most important task for good organic wheat production. Badly degraded soils can take some time to transform sufficiently to produce acceptable yields and quality, and lighter soils can be slower to recover than heavier soils.

Preparing a paddock for organic wheat production is a *cycle of events* beginning with the last wheat crop. Under-sowing this crop with clover can be considered as the first step in preparing for the next wheat crop. The under-sown clover is used to provide sufficient seed for a good clover-based pasture to establish the next season.

Over several years a good legume-based pasture should accumulate sufficient soil nitrogen for the next wheat crop. At least two years of strong clover-based pasture (or other nitrogen-fixing legume) is likely to be required. A longer *pasture phase* may be needed on light soils to maintain long term sustainable soil fertility levels.

The pasture phase can be used to:

- build-up the biological, physical and chemical components of soil fertility;
- control weeds; and
- control pest and disease.

If clover regeneration in pasture is likely to be poor after cropping, then clover may be directly sown at the start of the first pasture season. The cost-benefit ratio of sowing clover seed as a separate operation may be improved by adding other desirable pasture species to the seed mix to increase pasture feed quality or to gain other benefits. For example, oats, peas and vetch can be sown for feed, or possibly lucerne or other perennials if water balance requires management.

Pasture management becomes very important over the years before cropping if weed control benefits are to be effective. Animal grazing is an obvious way of managing pasture growth.



Timely grazing management can reduce weed burden

Fencing to soil type or productive unit is very important to enable heavy grazing on better soils without exposing poorer soils to erosion risk. Electric fencing to reduce paddock size can allow intensive grazing - using high stocking rates for a short duration. Newly shorn sheep quickly learn to avoid the electric fences.

Mobs of 3000 head in a 50 acre strip have been used for several days with good effect. The extra management required to move stock frequently can be reduced by fencing to a laneway system. One grower reports using three pet leader sheep who come when called to lead a big mob into a new paddock.

A high impact and short duration *rotational grazing system* can offer the following benefits:

- more effective grazing pressure;
- better pasture and weed control;
- maximum time for soil to recover from grazing and compaction pressure; and
- allow stock parasite cycles to be broken.

However, grazing pressure is often insufficient to manage pastures over an entire property, particularly during the spring flush. *Mechanical pasture topping* can be used just prior to flowering to reduce weed seed set and contribute to soil organic matter accumulation.

The first pasture year can be used to establish a strong clover (or other nitrogen-fixing legumes) base and generate biomass to replenish soil organic matter reserves. Pasture should be managed to maximise legume growth and reduce grass and weed growth, and seed set. Grazing and pasture topping can be used to manage pasture species and prevent weed seed set.

Soil tests may be taken to monitor changes in soil conditions, guide decisions regarding the fertility status of the soil and any need for **soil amendments**. A number of alternative approaches are being used to interpret soil test results. Appendix 3 outlines several of these concepts for consideration.

Additional years of pasture may be required if soil fertility remains low, if weed control is poor or disease control is inadequate. Minimising weed seed set is extremely important.

The final pasture year can be used to apply soil amendments and bring soil fertility into balance.

Where hard pans exist or soil structure and biological activity is shallow, **deep ripping** (at a depth of only about 10-15 cm below existing activity) can accelerate the development of deeper fertility.

The depth of ripping can be progressively increased over time in accordance with the actual depth of soil biological development. Deep ripping is likely to be most effective when soil is still dry enough to cause cracking or fracturing to extend between tines, allowing biological activity to penetrate. Ripping when soil is too wet can cause smearing and must be avoided. Prior to ripping, soil amendments such as lime, dolomite, gypsum, reactive phosphate rock and other minerals may be spread to get some soil penetration benefit from the ripping operation.

Application of **soil biological inoculants** are used by some growers to assist soil biological activity. Application is often early in the season when soils are moist but while some soil warmth remains. Examples include formulations such as SC27 or Bio 3/20 microbes (sometimes applied with sugar as an energy source) or stimulants such as biodynamic preparation 500.

Good **weed management** is very important in the final pasture year. Intensive short duration grazing pressure, pasture topping and possibly ploughing-in pasture as a green manure can be used to control weeds. Turning in a pasture just prior to flowering stage can provide additional organic matter, nitrogen and other nutrients to the soil.

This cultivation can also be used as an alternative opportunity to incorporate various soil amendments at a time when the decomposition of the **green manure** can help mineralise the applied amendments. Alternatively, at the end of the pasture phase, the stand can be cut for hay or grazed very hard (or

sometimes both), then left until there is seed germination before cultivating with a scarifier.

Grazing management can be used to control weed regrowth due to late spring or summer rains. The benefits of summer scarifying for weed control or fallowing for water conservation must be carefully considered against the cost of reductions in soil organic matter levels, and the increased risk of soil erosion.

Longer pasture phases and less cultivation increases soil root mass and lowers the **erosion risk** associated with leaving soils bare. Once land has been grazed down for cropping, animals must be removed to prevent surface powdering from stock traffic (which increases erosion risk).

Paddocks well prepared for cropping should have a low weed burden with minimal cover sufficient to protect the soil from erosion. Soil amendments will have begun mineralising and nutrient build-up should have reached adequate levels. Soil biological activity should have rebuilt good soil structure to greater depth. Pest and disease cycles should have been broken.

Sowing a wheat crop

Consider which **wheat varieties** will perform well under organic production. New wheat varieties are often selected to perform with high input of chemicals and fertilisers. In contrast, older varieties are bred to perform with less chemicals and fertilisers, and may have better root systems with more feeder roots and generally more vigour and stronger emergence.

Apart from market requirements, choose varieties with good vigour under organically prepared soil conditions, pest and disease resistance, quick growth, good coverage and which are well equipped to handle a degree of weed competition. Due to the reliance on cultivation for pre-planting weed control, medium to short season varieties are likely to be more suitable to achieve optimal flowering time.

Sowing a mix of varieties has been reported in the United Kingdom to give greater yields than planting a single variety. Careful selection of varieties must ensure that the quality characteristics of the mix meet market requirements, as separation after harvest may not be possible.

Optimal seeding rates for organic wheat are not known. The relatively low cost of seed and generally little impact of high seeding rates (up to 150-200 plants per square metre) on reducing yield, suggests that dense plantings may be useful to

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give better weed competition. However, very high plant populations may cause small grain and high screenings in very dry years, especially for small grain varieties (although low rainfall at grain filling and potassium deficiency are the more likely causes of small grain screenings).

Following the opening rains and a good weed germination - under ideal conditions where previous **weed control** has been very good - some growers report that the crop can be sown without working up by using a seeder set-up to give a good weed kill. Timing is the key for effective weed kill.

However, more often a paddock will first be worked up with disc ploughs or scarifiers following the opening rains and good weed germination. Effective weed control is far more likely if weather conditions are dry and windy.

Very wet soils compact easily so **cultivation** at the correct soil moisture level is very important to avoid compaction. Excessive cultivation speed can pulverise soil structure and must be avoided.

A good second germination generally signals the time for sowing, provided adequate earlier weed control has been achieved. The seeder should be set-up to give an effective weed kill. A prickle harrow chain can be run behind the seeder to give additional weed kill and flatten any ridges left by the cultivator or seeder. This helps reduce evaporation by minimising soil surface area. If required, the crop can be under-sown to clover.

Where deficiencies remain, acceptable **soil nutrient inputs** such as pelletised or granular formulations may be drilled at seeding. Press wheels or rollers can be used to assist good crop germination and have been reported to possibly limit some weed germination. An additional pass with heavy harrows or prickle harrows after seeding, but before crop emergence, can be used to kill weeds that survive the sowing pass or have newly germinated.

Crop development may progress at a different rate than under a conventional system. Early growth can be slower, although the difference becomes less noticeable over time. As soil structure improves, growers report that crops are 'holding better in dry spells and finishing later, which means they continue growing longer before maturing'. The crop is unlikely to be weed-free, but if effective weed control was achieved before seeding, the weed burden is not likely to be an economic problem.



Economic weed control

Excessive weeds in young crops have been controlled with the use of prickle harrows or carefully managed **grazing** with sheep.

Pest and disease problems are generally reported to be minor and growers report that treatment is rarely justified. In some instances a pest outbreak such as mites will appear, but farmers often allow these to run their course without noticeable impact on the crop. In extreme events, a range of allowable pest or disease control substances is available for use.

Organic standards and certification

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

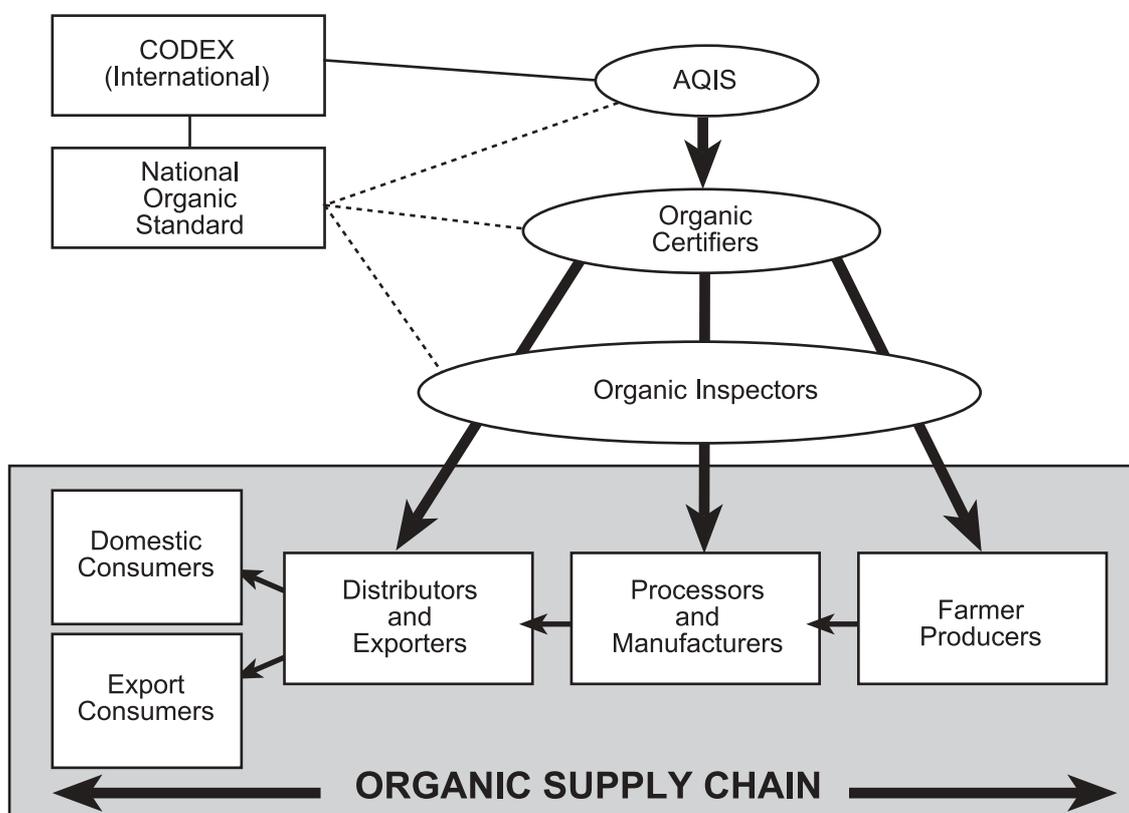
This section describes in general terms the requirements and procedure for gaining organic or biodynamic certification within Australia.

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)

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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 AQIS accredited organisations for product labelled as organically grown.

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

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).

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 as 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 product, 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 in place and that it successfully operates 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. AGWEST Farmnote No. 138/2000.

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

Organic Farming. Nic Lampkin 1990. Farming Press UK.

Acres Australia. – alternative farming newspaper - various editions.

Alternate Farmer - alternative farming magazine - various editions

The Wheat Book - A Technical Manual for Wheat Producers. Agriculture Western Australia.

Conversion to Organic Agriculture in Australia: Problems and possibilities in the cereal and livestock industry. The National Association for Sustainable Agriculture Australia.

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

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

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 4895

E-mail: plowe@vision.net.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

Substances	Specific conditions
Slurry from certified sources	-
Aerobic compost	Compost is the conversion of organic materials into humus colloids
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 sulphate)	From natural sources
Calcined or rock phosphate and other crushed mineral bearing rocks	Excluding those minerals which are more than 20 per cent soluble
Phosphoric guano	-
Rock potash and sulphate potash	-
Wood ash	From untreated sources
Sulphur	-
Clay, bentonite	-
Attapulgate	-
Perlite	-
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	Not synthetically chelated elements
Homeopathic preparations	-
Approved microbiological and biological preparations	-
Naturally occurring biological organisms (e.g. worms and worm castings)	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
Pyrethrum extracted from <i>Chrysanthemum cinerariaefolium</i>	Without piperonyl butoxide
Rotenone extracted from <i>Derris elliptica</i>	-
Quassia extracted from <i>Quassia amara</i>	-
Neem oil and extracts	-
Ryania extracted from <i>Ryania speciosa</i>	-
Propolis	-
Diatomaceous earth	In non-heat treated form
Stone meal	-
Meta-aldehyde baits	In traps or enclosed from the environment
Baits for fruit fly	Substances as required by statutory regulation and must be fully enclosed within traps
Copper, in forms such as Bordeaux mixture and Burgundy mixture	Hydroxide is the preferred form except for Bordeaux on dormant tissue
Sulphur in a wettable or dry form	-
Sodium silicate (waterglass)	-
Sodium bicarbonate	-
Potassium soap (soft soap)	-
Biological controls	Naturally occurring organisms and approved cultured organisms such as <i>Bacillus thuringiensis</i>
Pheromones	-
Granulose virus preparations	-
Essential oils	-
Vegetable oils	-
Light mineral oils (white oil)	-
Seaweed, seaweed meal, seaweed extracts, sea salts and salty water	-
Homoeopathic preparations	-
Natural plant extracts, excluding tobacco, such as garlic extract, etc. and used as a repellent, antifeedant or pest/disease control	Obtained by infusion and made by the farmer without additional concentration
Potassium permanganate	-
Carbon dioxide and nitrogen gas	-
Vinegar	-
Wetting agents	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

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

Substances	Specific conditions
Pyrethrum extracted from <i>Chrysanthemum cinerariaefolium</i>	Without piperonyl butoxide
Rotenone extracted from <i>Derris elliptica</i>	-
Quassia extracted from <i>Quassia amara</i>	-
Neem oil and extracts	-
Garlic oil, garlic extract or crushed garlic	-
Seaweed, seaweed meal, seaweed extracts, sea salts and salty water	-
Sulphur	-
Potassium permanganate	Homoeopathic preparations
Natural plant extracts obtained by infusion	Excluding tobacco
Essential oils	-
Methylated spirits	-
Tallow	-
Cider vinegar	Certified organic
Nettle	-
Diatomaceous earth	Non heat-treated form
Selenium and other trace elements	To correct identified deficiencies only
Zinc sulphate	-
Copper sulphate	-
Vitamins	-
Biological controls	-
Charcoal	-
Clay	-
Vaccines	-
Wetting agents	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
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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, with 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 (fruiting 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.