Australian Macadamia Industry Code of Sound Orchard Practices

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Foreword

The Australian Macadamia Industry Code of Sound Orchard Practices (COSOP) has been produced to provide growers with an authoritative *best practice* guide. This is the first total rewrite of the code and we believe that it reflects our increasing standards and will further advance the Australian macadamia industry.

The Australian Industry has developed a reputation for producing macadamias of the highest quality, free from chemical residues and microbial contamination. The adoption of COSOP will ensure that we maintain and improve our world standing in the market place.

Food safety and quality management starts on the farm and should continue throughout the supply chain. COSOP is just part of the industry wide quality assurance program. It compliments the Macadamia industry Approved Supplier Program and the ISO 9002 and HACCP (Hazard analysis and critical control points) quality and food safety systems that all major Australian macadamia processors have. Growers who follow these guidelines will produce good quality, safe nuts that meet the processors requirements.

This new edition of COSOP reflects the domestic and international trend towards guaranteeing safe food, while retaining the flexibility necessary to accommodate differing growing methods. The taskforce who put this manual together have drawn widely on industry expertise and experience. The manual will be continually updated as our knowledge and experience grows.

This manual is a reference for Australian growers and is tended to generate confidence with the buyer that Australian macadamias are of the highest quality.

Rod Fayle
AMS president, November 2000.

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Readers must note that the information contained in this code has been developed for growers in Queensland and New South Wales in Australia and the Australian Macadamia Society gives no warranty that the information if suitable for conditions outside Queensland and New South Wales in Australia.

The Australian Macadamia Society and the authors have taken all reasonable steps to ensure the information contained in this publication is accurate at the time of publication. Readers should ensure that they make appropriate enquiries to determine whether new information is available on the particular subject matter.

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Introduction

The Australian macadamia industry's reputation on world markets for nut quality and food safety is a major competitive advantage. This reputation could easily be jeopardised through the effects of unsound management practices on individual farms.

As suppliers of a raw material to processors, each grower is responsible for the quality and food safety of his or her nuts. Growers also need to strongly consider the effect of their farm practices not only on the quality of the nuts when they are delivered to the processor but also when they reach the final consumer.

Nut quality (NQ)

The International Macadamia Quality Standard describes the quality of macadamias as being judged by the buyer/consumer and being essentially the delicate characteristic flavour, crunchy texture and freshness.

Macadamia farm management practices have a major effect on quality of the nuts reaching the final consumer. The Macadamia Industry Code of Sound Orchard Practices addresses the critical steps in macadamia production where nut quality may be affected.

The AMS Recommended Minimum Standard for Macadamia Nut-In-Shell (NIS) is attached to the code. This provides growers with a minimum quality specification to achieve. As well as these minimum standards at delivery, there are also many farm management practices, such as harvesting, drying and storage that have a major affect on shelf life.

Food safety (FS)

Food safety management is extremely important in the Australian macadamia industry. Purchasers of Australian macadamias should be confident they are buying a consistent product with no risk of any ill effects.

The major potential food safety hazards are:

- Chemical residues, such as from the use of unregistered pesticides.
- Pathogens such as *Salmonella* and *E. coli.*
- Harmful foreign matter such as impacted shell or broken glass - The presence of broken glass has led to the dumping of entire consignments of other horticultural crops.

Contamination by any of these food safety hazards would have major repercussions on the reputation of Australian macadamias. The code addresses key steps in macadamia production to ensure that the risk of contamination is properly managed.

The Macadamia Industry Approved Supplier Program has been developed to ensure Australian Macadamias meet the food safety and quality requirements of major markets around the world. The Approved Supplier Program details good agricultural practices that give customers the assurance that Australian grown Macadamias are of acceptable quality and are safe to eat.

Sustainable management (SM)

Macadamia orchards need to be managed to ensure there are no adverse effects on farm natural resources, neighbours or the surrounding environment. This includes the management of issues such as soil and nutrient runoff, and the prevention of spray drift.

The code is designed to identify key areas that need to be addressed in macadamia production rather than as a comprehensive guide to sustainable management of macadamias in Australia. Growers seeking further information should refer to publications such as *Farmcare*.

Workplace Health and Safety (WS)

As employers or self employed people, macadamia growers are responsible to ensure that their business does not cause a risk to the health and safety of themselves, their employees, other persons in the workplace or members of the public.

There are many areas in macadamia production where risks to health and safety can occur. The AMS has developed an industry specific "Workplace Health and Safety Manual" and training course. Contact the AMS for further details. The code does address, however, a number of key issues relating to the use of pesticides and health and safety in the workplace.

Agronomic best practice (AP)

Many of the practices outlined in the code are also aimed at maintaining healthy tree growth and performance.

Legislation

Macadamia growers must keep up-to-date with all relevant legislation affecting their operation. They also need to be aware of all relevant local government by-laws.

Record keeping

Adequate record keeping is an essential part of any quality management system. Processors need to know how nuts have been handled on the farm to satisfy food safety and quality regulations and customer requirements. Record keeping also enables growers to identify areas in farm management where improvements in efficiency can be made.

The Approved Supplier Program requires growers to keep sufficient records to demonstrate that good agricultural practices are a fact of everyday operation. The processors or third party auditor will periodically check that growers are carrying out the practices and keeping the required records.

The MacMan farm recording system is recommended as it is specifically designed to meet the needs of Australian macadamia growers. It is simple to use and delivery reports can be produced to meet processors' food safety and quality needs. Both computer and paper based systems are available.

The role of the code

The code is designed as a guide to growers on managing their orchards to improve their nut quality and reduce potential hazards to food safety, sustainability and workplace health and safety. It is not designed as a recipe book on how to grow macadamias. Growers seeking this information should consult the publications listed in the Further reading section.

The original Macadamia Industry Code of Sound Orchard Practices was published by the Australian Macadamia Society in 1992 and updated in 1993. It was based on the current knowledge at that time on the effect of management practices on macadamia nut quality.

Since the publication of the original code, research and development, as well as grower and processor experience, have led to major advances in the knowledge of how to manage nut quality in macadamias. Food safety, sustainable farm production practices, workplace health and safety, and legislation covering farming practices have also become increasingly important.

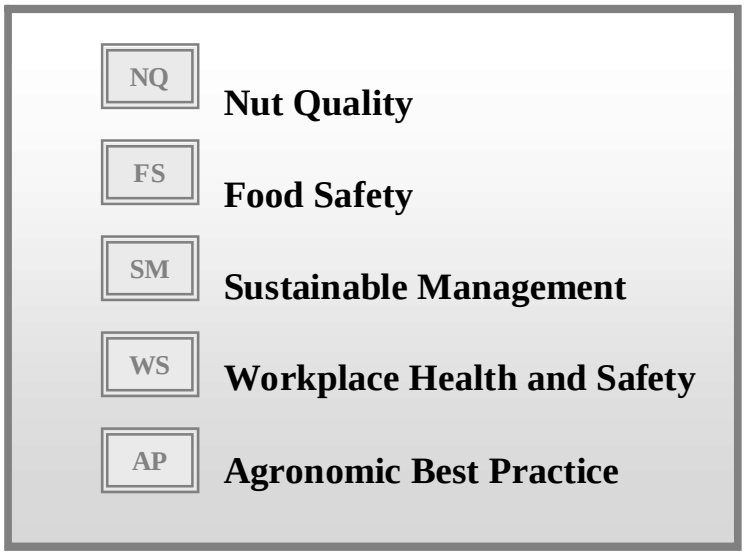
In developing this document, the task force is also aware that no two orchards are the same. Many orchardists have different methods of completing the same task without compromising quality or food safety. The processor should be made aware before taking delivery of the nuts, however, of practices where quality or food safety may have been affected so they can decide on how the nuts should be treated.

The Code of Sound Orchard Practices should be used in conjunction with the Approved Supplier Program and Workplace Health and Safety manuals. Contact the AMS for details on industry specific training on the Workplace Health and Safety and the Approved Supplier Program.

Identification system

In the Code, each section is divided into a recommendation in bold type, followed by an explanation in plain type. An identification system has been used in this document to enable growers to quickly and easily trace the recommendations relevant to particular aspects.

Some of the sections are relevant to more than one of these issues; eg a section may have relevance for food safety, nut quality and sustainable management. Where this occurs, the symbols of all the relevant aspects are in the margin next to the recommendation



A number of points in the code have also been identified as key recommendations. These require particular attention to ensure that nut quality or food safety are not compromised. These points have been identified by a grey border (as in the box above).

Section 1 Orchard establishment

1.1 Site selection

NQ	FS	SM
WS	AP	

1.1.1 Recommendation - Avoid poorly drained soils, excessively steep slopes and contaminated sites.

Macadamias perform best on deep, well-drained soils, rich in organic matter. Trees planted in poorly drained soils are more prone to poor growth and performance, tree decline and trunk canker.

Steep slopes are susceptible to unsustainable levels of soil erosion, leading to reduced tree performance and possible tree decline. Soil erosion can also lead to an increase in foreign matter adhering to the nuts. Close attention needs to be paid to soil erosion management. Measures such as surface drains and vegetative ground cover are required on sloping ground.

Harvesting, pesticide application and other management operations are more difficult on steep slopes and can be delayed, particularly during wet weather. It is also more costly to manage macadamia orchards on steep slopes.

Contaminated sites (eg old cattle dips or dumps used for agricultural chemicals) increase the risk of chemical contamination of the nuts, as well as posing a health risk to workers.

NQ	SM	AP

1.1.2 Recommendation - Avoid extremely hot or wet sites, or locations exposed to high cyclone or storm activity.

Macadamia trees planted where maximum temperatures regularly exceed 35ºC during the later stages of nut development are subject to increased premature nut drop and decreased kernel recovery, kernel size and first grade kernels.

Sites with extremely wet weather are prone to:

- Difficulties and delays with harvesting nuts with a subsequent increase in discoloured kernel, germination, mould and rancidity,
- Difficulties and delays with pesticide application,
- Increased foreign matter adhering to the nuts,
- Increased risk of soil compaction due to harvesting and other machinery operating on wet soils,
- Trees in soft wet soil are susceptible to being blow over.

Macadamia trees are very brittle and break easily. Strong winds and tree damage during storms and cyclones can cause nuts to drop before they have reached maturity. If these are not removed, it can result in a higher level of immature nuts during harvesting.

1.2 Orchard layout

SM AP

1.2.1 Key recommendation - Develop a whole farm plan

A whole farm plan is a very important tool in the establishment and management of the orchard and the optimum use of natural resources. A whole farm plan should include a map of the farm and neighbouring areas and a strategic plan for the farming enterprise.

SM

1.2.2 Recommendation - Plan orchards so that water flow is managed to minimise soil erosion and nutrient runoff. Maintain a stable ground cover and do not plant trees where water runoff concentrates or in natural drainage lines and depressions.

Uncontrolled water flow on bare soil can lead to soil erosion and nutrient runoff. Closely planted, mature orchards where shading has reduced vegetative ground cover need careful management to ensure this does not occur.

Establish surface drains and maintain vegetative ground cover in the orchard to control water flow. It is particularly important to maintain a stable ground cover in all surface drains or anywhere else water runoff concentrates.

1.2.3 Recommendation - Plan the orchard to avoid spray drift onto neighbouring properties.

SM

The best way to cut down the chance of off-target spraying is to ensure the efficient and careful application of chemicals. Buffer zones can also reduce the potential impacts of spray drift (*Farmcare* 1998). Consider likely prevalent wind directions and the proximity of neighbouring properties when planning the orchard.

1.2.4 Recommendation - Plan the position of dehusking shed and silos to avoid raising complaints from neighbours.

Position dehusking sheds and silos well away from neighbouring residential properties. Openings to any sheds should be placed in the opposite directions to residential neighbours. Topographical features can be utilised as natural acoustic barriers. Further information on noise control is available in "Noise Study for the Australian Macadamia Society, August 2003" is available on the AMS website.

WS AP

1.2.5 Recommendation - Consider machinery requirements when designing the orchard.

Ensure easy and safe machinery access and use. On slopes greater than 8%, run the rows up and down the slope for safe machinery use.

Avoid short rows (less than twenty trees in length) as they are inefficient for machinery operation. Long, even rows are preferred. Allow sufficient access room at the end of rows for turning and for loading and unloading. With very long rows, access at regular intervals will also be required for unloading harvest bins or refilling spray tanks.

NQ AP

1.2.6 Recommendation - Plant at least two varieties in any block. Do not plant more than one variety in the same row.

Layout of varieties in a block is a compromise between the benefits of cross-pollination and maximising harvest and orchard management efficiency. Cross-pollination between selected varieties increases the number of nuts, the percentage of first grade kernel, kernel recovery and nut size. It is preferable to arrange the rows in the block so that each variety is no more than five rows away from another variety.

Planting different varieties in the same row can lead to problems with harvesting times and crop protection requirements. Mixing early season and late season varieties in the same row will result in inefficient labour and machinery operations, as extra harvests may be required. Different varieties also have different tolerances of pests and diseases, and may need different spray programs.

1.3 Nursery trees

AP

1.3.1 Recommendation - Select healthy, pest, disease and weed free nursery trees.

Avoid planting nursery trees with:

- Stem damage or trunk canker,
- Damaged, root bound or deformed root systems,
- Bent or deformed stems,
- Insect pests such as felted coccid or latania scale, or
- Infestations of weeds such as tropical chickweed

Section 2 Orchard management

2.1 Animal management

FS

2.1.1 Key recommendation - Domestic grazing animals should be excluded from the orchard during harvest. Where domestic animals are removed from the orchard less than four months before harvest, the NIS should be sanitised prior to storing in silos or delivery to processors. Where possible, the presence of vermin in the orchard should also be reduced.

Salmonella has been found to persist for up to three months in chicken and sheep manure that has not been properly composted. It has also been found in nut husk heaps. Grazing domestic animals in the orchard in the four months prior to harvest can increase the risk of contamination of the macadamia kernel with pathogens such as *Salmonella* and *E. coli*.

Vermin (such as rats) are less easy to exclude totally from the orchard. Where possible, steps should also be taken to reduce their presence in the orchard to lessen the risk of microbial contamination, including:

- Remove any harbourage for rats within or close to the orchard,
- Maintain a wide mown strip around the orchard perimeter,
- Ensure as few nuts as possible are left on the ground after harvesting is completed, and
- Avoid dumping nut waste from grading and sorting in and around the orchard.

FS SM

2.1.2 Key recommendation - Any baits used for rat control in macadamias should be monitored regularly and used only in approved bait stations to avoid contamination of nuts.

The use of rat baits in macadamia orchards presents a potential chemical contamination hazard to the nuts and the environment. They are also a threat to wildlife if they are not used correctly. Rat baits registered for use in macadamias specify the bait stations that can be used. Rat baits in macadamia orchards must only be used in these bait stations.

Rats prefer the seclusion of covered stations and it also protects the bait from rain. All stations must retain the bait so that it does not spill on the ground or be able to be picked up during mechanical harvesting. Stations must also cover the bait to prevent access by birds. Baits must not come in contact with the ground or water.

2.2 Fertiliser management

NQ AP

2.2.1 Recommendation - Monitor soil and leaf nutrient levels and correct any deficiencies and imbalances. Use standard sampling procedures and quality assured laboratories for analysis. It is recommended to maintain consistency in sampling sites, timing and laboratories to better understand crop nutritional trends in the orchard.

Soil and leaf analyses provide guides to the availability of nutrients in the soil and uptake by the tree. Comparisons can be made with optimum levels set for healthy, bearing trees. Nutrient deficiencies and imbalances can lead to poor tree performance and reduced kernel quality.

It is important that the analysis interpretation and fertiliser recommendations are clearly linked to an understanding of the soil test, soil type, crop agronomy and the timing of growth cycle events (eg nut growth and oil accumulation) under local climatic conditions. Recommendations should also consider nutrient replacement requirements from crop removal and allowances for tree growth and other losses. It is recommended to seek advice from someone with appropriate qualifications and a sound knowledge of local conditions and macadamia management in developing a fertiliser schedule.

Sampling, analysis, interpretation of results and the development of recommendations are all critical steps in developing an appropriate fertiliser schedule.

SM

NQ

2.2.2 Recommendation - Avoid excessive fertiliser use.

Fertiliser can be applied in macadamias using a number of different methods, including broadcasting or banding, in sprays applied to the foliage or ground, or through an irrigation system. Whichever methods are used, monitoring of nutrient application and uptake is required to avoid too much or too little fertiliser being used.

Over use of fertiliser is an unnecessary cost, can induce deficiencies of other nutrients and can lead to environmental problems such as high levels of nitrogen and phosphorus in watercourses.

Timing of fertiliser application is also important to maximise the benefit to yield and quality of the fertiliser and to reduce the risk of losses to the environment through volatilisation, leaching and runoff.

NQ

2.2.3 Key recommendation – Do not apply more than 20% of the total annual nitrogen application during summer.

Heavy nitrogen applications during summer can promote excess vegetative growth. This competes with the developing kernel for carbohydrate reserves, leading to decreased first grade kernels, kernel recovery and shelf life.

2.2.4 Key recommendation - Avoid the application of animal manures that have not been properly composted or nut husk from heaps at least four months prior to mature nut drop until the completion of harvest.

Salmonella has been found to persist in animal manures that have not been properly composted for up to four months and has also been found in nut husk heaps. The application of animal manure, or nut husk that has not been

properly composted, in the four months prior to mature nut drop until the end of harvest is a food safety risk. Proper composting of animal manures involves storing in heaps for at least 3 months with regular monthly turning prior to application.

2.2.5 Recommendation - Locate stockpiles of animal manures or fertilisers to avoid the potential for runoff into watercourses or orchards.

Stockpiles of fertilisers and animal manures located where runoff into watercourses can occur can lead to high levels of nutrients such as nitrogen and phosphorus in the water.

Runoff from stockpiles of animal manures into watercourses or orchards also presents a risk of spreading pathogens such as *Salmonella*.

AP NQ

2.2.6 Recommendation - Maintain records of the fertiliser program.

Accurate records are an important part of monitoring the effects of fertiliser applications on yield and quality. They also provide a basis for decision-making for future applications. Farm recording systems such as MacMan and the Approved Supplier Program are designed to enable macadamia growers to quickly and easily keep records of fertiliser products, rates and timing.

2.3 Irrigation management

FS NQ

2.3.1 Recommendation - If irrigating, ensure the irrigation water is of good quality.

Unsanitary irrigation water poses a risk of microbial contamination to the nuts. Water may need to be tested to assess the risk of contamination. If the water is used for spraying the pH should be measured and adjusted if required.

Irrigation water with excessive salt levels may also result in poor tree performance and reduced kernel quality.

SM

2.3.2 Recommendation - If irrigating, ensure the irrigation system is operating efficiently, monitor soil moisture and schedule irrigation to avoid wastage.

Inefficient irrigation systems are wasteful of money and resources. Management tools such as tensiometers, neutron probes and capacitance tools enable growers to monitor soil moisture levels and tree requirements. Scheduling matches available irrigation water supply with tree demand for maximum yield and quality.

2.4 Soil management

NQ SM

2.4.1 Recommendation - Maintain sound cultural practices that will sustain soil structure and minimise erosion and provide an environment for healthy root development. Monitor for soil erosion in the orchard and where necessary, take prompt steps to correct the problem.

Soil compaction and low levels of organic matter can cause reduced root development leading to poor tree performance and reduced kernel quality. Avoid the overuse of heavy machinery on bare, wet ground, particularly in soils with a high clay content.

Water flowing along tree rows can:

- Remove nuts and soil from beneath trees
- Expose tree roots
- Increase the amount of foreign matter adhering to the nuts, and
- Increase the risk of microbial contamination.

Use surface drains and/or vegetative ground cover in the orchard to control water flow. Maintain vegetative ground cover in waterways to minimise soil erosion and nutrient loss. Canopy management may be required in mature orchards to allow sufficient light to the orchard floor for ground cover establishment and maintenance.

2.5 Pest and disease management

NQ	SM	FS

2.5.1 Recommendation - Monitor regularly for pests and diseases. Pest management advisers need to be well-trained and up-to-date with pest monitoring and management systems.

Spotting bugs, green vegetable bugs, nut borers and other insects can increase unsound kernel and premature nut drop. Damage by vermin such as rats can cause kernel loss and possible microbial contamination. Husk spot and anthracnose can result in increased premature nut drop.

Pest monitoring and management systems are complex and are being continually fine-tuned. They require a detailed understanding of the pest, macadamias and available control measures. Integrated pest management systems are preferred where all available forms of pest suppression (biological, physical, chemical etc) are used to lower pest populations safely, economically and in an environmentally acceptable manner.

FS

2.5.2 Key recommendation - Use only pesticides registered or permitted to be used in macadamias by the Australian Pesticides and Veterinary Medicines Authority (APVMA). Follow label directions and observe withholding periods..

The use of pesticides not registered or permitted by the APVMA or the failure to follow the label or off-label permits or observe withholding periods may lead to unacceptable chemical residues and the potential loss of key markets. A withholding period is the minimum recommended interval that should elapse between the last application of a chemical product to a crop and its harvest (*APVMA Information for farmers – frequently asked questions*). Details of registered or permitted pesticides for use in macadamias can be found in publications such as *Infopest*.

NQ FS SM WS

2.5.3 Recommendation - Pesticide users need to be appropriately trained and accredited.

The APVMA requires all purchasers and users of endosulfan to be appropriately certified. It is recommended that users of all pesticides in the macadamia industry be appropriately trained and accredited to promote worker, food and environmental safety and efficient pest management.

NQ SM WS

2.5.4 Recommendation - Use suitable spray equipment that has been calibrated under field conditions at least annually.

Use of unsuitable spray equipment for the job, or spray equipment that has not been properly calibrated, can be inefficient, unsafe and wasteful. It can also result in poor pest control leading to a decrease in nut yield and quality. Spray equipment needs to be calibrated in the orchard to ensure sufficient coverage of the tree canopy for the situation. All of the following are important when calibrating spray equipment:

- Tractor speed,
- Pressure gauge settings,
- Air volume,
- Chemical rates,
- Nozzle selection and
- Target pests or diseases.

Information on equipment used in the application of chemicals and the conditions necessary for its safe use also needs to be available to all staff using the equipment.

FS

2.5.5 Recommendation - Turn off silo fans when spraying near silos containing nuts.

Spraying near silos containing nuts when silo fans are operating may lead to unacceptable chemical residues in the nuts.

WS

2.5.6 Recommendation - Pesticide container labels, off-label permits and Material Safety Data Sheets need to be available to anyone responsible for pesticide storage and use.

Any person with responsibility for the storage or use of pesticides requires the following information:

- Pesticide container labels. All pesticide containers must be labelled to ensure the contents of the container can be readily identified and used correctly.
- Off-label permits. Where a pesticide is not registered for use in macadamias but an off-label permit exists, a copy of the permit needs to be readily available.
- Material Safety Data Sheets (MSDS). These contain information on the hazards associated with a substance. A supplier must provide an MSDS for each hazardous substance supplied to you with the first supply and when you request it. You should ensure that an MSDS for each hazardous substance is readily available for each person storing or using it.

Further information on the safe use and storage of chemicals in agricultural workplaces can be found in publications from Workplace Health and Safety (Qld) and WorkCover (NSW), and in the Macadamia industry Workplace Health and Safety Manual and the Approved Supplier manual.

WS

2.5.7 Recommendation - Exposure of people to hazardous substances needs to be eliminated or minimised. Personal protective equipment, as specified on the pesticide label or MSDS, needs to be available and worn. Observe re-entry periods into the orchard.

Control measures need to be adopted that eliminate or reduce as far as practicable the exposure of any person to hazardous substances.

Personal Protective Equipment as specified on the chemical label and MSDS must be worn. It should be appropriate for the task, acceptable to the wearer, readily available, clean and in a fully operational condition, and suited to the employee. Chemical filters on air conditioned cabs in tractors also need to regularly maintained.

Re-entry periods are important to observe where contact with foliage and skin is unavoidable. Many pesticides and weedicides such as paraquat are readily absorbed through the skin. Where no re-entry period is stated, as a minimum, re-entry by unprotected persons should not occur until dusts have settled or sprays have dried.

WS SM

2.5.8 Recommendation - Minimise risks of off-target spray drift.

The following are important considerations in reducing the risk of off-target spray drift and potential hazards to human health and safety and the environment:

- Spray equipment being used,
- Weather conditions eg wind direction and speed
- The distance from the application site to areas of potential risk, and
- Any barriers between the application site and areas of potential risk.

WS SM

2.5.9 Recommendation - Store pesticides in a well-ventilated and well-lit shed. The store should have an impervious floor and shelving. It should also

be kept locked and have a childproof latch. Store pesticides away from respirators, protective clothing and equipment, foodstuffs, animal feeds, fertilisers, seeds and other chemicals. Avoid storing pesticides in flood-prone areas and potential watercourses.

The amount of chemicals and their characteristics, the duration of storage, and the control of potential emergencies such as spillage or fire need to be considered in designing chemical storage. Chemicals need to be stored so they do not present a potential safety risk to people, animals or the environment or so that they cannot contaminate nuts or other foodstuffs. It is also important to ensure there is no potential risk of pesticides entering watercourses.

It is important when using pesticides that poison drums are not left at water fill up points, particularly in flood-prone areas or near potential watercourses.

WS SM

2.5.10 Recommendation - Maintain a stock inventory of the chemicals in storage. Do not store more than one season's chemical requirements.

A stock inventory is not only important for efficient farm management but also is necessary should an emergency occur. Reducing the amount of chemicals stored on the farm is an important method in reducing chemical storage hazards. Many chemicals also have a limited shelf life.

NQ AP

2.5.11 Recommendation – Maintain records of pest and disease monitoring results and all pesticides applied.

Accurate records are a requirement of the Macadamia Approved Supplier Program and an important part of monitoring the effectiveness of pesticide applications on yield and quality. Growers also need to meet their legal obligations with pesticide application records. Farm recording systems such as MacMan are designed to enable macadamia growers to quickly and easily keep records of pests, diseases and pesticides applied.

Section 3 Harvest management

3.1 Pre-harvest preparation

NQ

3.1.1 Key recommendation - Ensure unsound, old or immature nuts are removed or finely chopped before mature nut drop. Any impediments to harvest such as excessive leaf or foreign matter should also be removed or finely chopped.

Nuts from the previous season, immature or insect damaged nuts reduce the kernel quality of the harvest if not cleared from under the trees prior to mature nut drop.

Inadequate orchard floor preparation can lead to harvesting difficulties and delays and an increase in unsound kernel.

NQ AP

3.1.2 Recommendation - Monitor maturity of nuts to determine the optimum time of pre-harvest preparation to ensure that only nut-in-shell that meets the required specification is consigned. (See Appendix 1 Recommended minimum standards for macadamia nut-in-shell offered to processors and Appendix 2 Recommended minimum standards for macadamia nut-in-shell offered for retail sale).

Optimum timing of pre-harvest preparation can have significant economic benefits. Early in the season, both mature and immature nuts can be falling. Timing the pre-harvest clean up too early can lead to excessive levels of immature nuts in the first harvest round. Late pre-harvest clean up can result in significant losses of good quality nuts.

3.2 Harvest

NQ

3.2.1 Recommendation - Harvest at least every four weeks if possible.

Picking up nuts as often as possible is important to maximise quality. Kernel quality will deteriorate the longer the nuts are on the ground due to mould and loss of shelf life due to rancidity, and increased germination during wet weather. Harvest interval particularly needs to be minimised where the nuts are exposed to direct sunlight or wet weather. The risk of microbial contamination also increases the longer the nuts are on the ground.

NQ

3.2.2 Recommendation - Keep nuts from different harvest rounds separate, particularly with early season harvests.

Early season harvests often have high levels of immature nuts and other quality problems. Mixing nuts from early season harvest rounds with later harvests can seriously reduce the quality of consignments.

NQ

3.2.3 Recommendation - Ensure efficient pick up when harvesting to avoid nuts being left on the ground until the next harvest round.

An inefficient harvest pick up will lead to excessive numbers of nuts left on the ground until the next harvest round. The deterioration in quality of these nuts will lead to an overall decrease in quality of the next harvest round. If mechanically harvesting, attention needs to be paid to the efficiency of harvesting machinery and the evenness of the soil surface.

FS

3.2.4 Recommendation - Inspect harvest containers before use and clean if necessary. Maintain harvesting machinery in a sound, clean condition. Ensure harvest equipment and other machinery is clean when shifting between orchards.

Unclean harvest containers (eg bins, buckets etc) or machinery increase the risk of contamination of the nuts. Incorrectly maintained harvesting machinery can cause cracking of the shell increasing the risk of mould, microbial contamination and bruising of the kernels. Unclean harvest equipment also presents a risk of spreading diseases, weeds etc when shifting between orchards.

Section 4 Post harvest handling

4.1 Post harvest handling shed and equipment

FS

4.1.1 Recommendation - Maintain the building in an orderly, sanitary condition and ensure all people handling nuts observe hygienic practices. Provide waste containers and frequently remove and properly dispose of waste, including reject nuts, from the working area. Monitor and take steps if necessary to prevent birds, rats or other animals entering the shed.

Poor shed and personal hygiene increases the risk of contamination of nuts. Birds, rats and other animals in the shed also increase the risk of microbial contamination. Reject nuts can lead to an increase in rat and bird problems if they are not disposed of properly.

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4.1.2 Recommendation – Install a monitoring system for recording daily movements through the shed of nut-in-shell and nut-in-husk.

It is important to record daily movements of nut-in-shell and nut-in-husk from the time of receival at the shed until delivery of the nuts to the processor. This is to ensure that nuts are treated appropriately to maximise quality. Suitable systems include the MacMan farm recording system (either the software or the diary) or something as simple as a whiteboard in a highly visible location in the shed.

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4.1.3 Recommendation - Provide sufficient guarding, lighting and ventilation to enable staff to work safely and efficiently.

Macadamia growers are responsible, as far as practicable, to ensure that their workplace does not cause a risk to the health and safety of themselves, their employees, other persons in the workplace or other members of the public.

Poorly lit and ventilated working conditions can result in staff being unable to work as efficiently as possible. Adequate lighting and ventilation is particularly important in ensuring sufficient and effective sorting.

4.1.4 Key recommendation – Ensure that there is no risk of contamination of the nuts by broken glass or other foreign matter.

FS

Contamination by broken glass has had extremely severe repercussions in other horticultural industries and the loss of entire export consignments. It is important to take practical steps necessary to ensure that there is no risk of contamination of the nuts by broken glass from fluorescent bulbs etc or by other foreign matter.

4.1.5 Recommendation - Ensure any rat baits used cannot contaminate the nuts.

Any rat baits used in or around farm buildings should be placed in covered bait stations in locations where there is a minimum risk of contamination of

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nuts. The stations should be inspected regularly and maintained, and their locations clearly identified.

4.1.6 Recommendation - Maintain equipment used for dehusking and sorting in a sound, clean condition. Sort rocks from nuts before dehusking.

Incorrectly set and maintained dehusking machinery can cause cracking of the shell increasing the risk of mould, microbial contamination and bruising of the kernels. Unsorted rocks can damage the machinery leading to inefficient dehusking and damaged nuts.

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4.1.7 Recommendation – Drying and storage equipment and vessels should be kept clean and maintained in good order. Ensure silo fans are working efficiently. Precautions should be taken to prevent contamination or wetting of nuts during handling, drying and storage.

Unclean and poorly maintained equipment, and unsecured containers increase the risk of contamination of nuts from insects, vermin and other pests, and from chemical or microbial contaminants or other substances. Buildup of material on silo fans can reduce their efficiency. Old nuts not removed from equipment and containers before use can also lower the overall quality of consignments.

Condensation inside storage containers such as silos or leakage from outside can lead to uneven drying of nut-in-shell and variable moisture content.

4.1.8 Recommendation – Design the shed and handling system so as to avoid prolonged exposure of nuts to direct sunlight.

Prolonged exposure of nuts to direct sunlight increases rancidity and increases cracking of the shell leading to possible contamination by pathogens.

4.2 Dehusking

4.2.1 Key recommendation – Dehusk nuts within 24 hours after harvest. If dehusking cannot be accomplished within 24 hours, nut-in-husk must be stored in a vessel with adequate and even forced air ventilation or spread out in thin layers to allow sufficient airflow between the nuts.

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Nut-in-husk generates respiratory heat in storage, particularly where the husk is wet or fleshy and green. This can cause an increase in mould, rancidity and germination.

4.3 Sorting of nut-in-shell

4.3.1 Key recommendation - Following dehusking, inspect the nuts and remove any foreign matter and nut-in-shell that is defective or less than 18 mm in diameter. Monitor rejected nuts during sorting by cracking a sample and recording the reasons for rejection.

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Insufficient or ineffective sorting will result in increased levels of unsound, immature or small nuts, or foreign matter being included in the consignment to the processor.

Monitoring rejected nuts during sorting and recording the reasons for rejection enables you to analyse your orchard management practices and their effect on macadamia nut quality. It also enables you to check sorting efficiency. Farm recording systems such as MacMan are designed to enable macadamia growers to quickly and easily keep records of rejected nuts during sorting.

4.3.2 Recommendation - Sort the nuts when they are dry.

It is easier to identify and sort defective nuts when they are dry. It may be necessary to conduct an initial sort immediately following dehusking to remove easily identifiable defects, such as rat damage, followed by a second sort when the nuts are dry.

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4.3.3 Recommendation - The nut-in-shell sorters should be adequately trained.

Training materials, such as the *Agrilink Macadamia Sorting Guide* poster can assist sorters to identify defective nut-in-shell. These should be readily available and visible, particularly for inexperienced sorters.

4.3.4 Recommendation - Spray wash nuts to remove the bulk of dirt and foreign matter.

Spray washing nuts is not a common farm practice in the Australian macadamia industry at this stage. However, dirt and foreign matter attached to nuts increases the risk of contamination by pathogenic bacteria such as *Salmonella*. Spray washing the nuts prior to flotation sorting or storage to remove the bulk of dirt and foreign matter reduces the risk of contamination. It is important that any water used in spray washing is free of pathogens such as *Salmonella.*

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4.3.5 Key recommendations - If you use on-farm flotation sorting of nut-in-shell, empty and hose out the water bath at least every four hours. Empty and sanitise the water bath at the end of each day it is used. Leave the bath empty overnight.

On-farm flotation sorting of nut-in-shell presents a major risk of contamination by pathogens such as *Salmonella*. Increases in time and water temperature can cause a rapid multiplication of *Salmonella* in solution. The concentration of *Salmonella* can multiply by up to 150 000 times in a water bath at 20ºC in 24 hours. Spray washing the nuts to remove the bulk of dirt and foreign matter before the water bath and regular changing of the water and cleaning of the bath reduces this risk.

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4.3.6 Recommendation - Monitor rejected nuts during flotation sorting to ensure that it is working effectively.

Flotation sorting of nut-in-shell is only effective for removing immature nuts if the nuts are at the optimum moisture content. The optimum moisture content of nut-in-shell will vary depending on kernel recovery (this can be affected by variety, season etc). Crack samples of nuts rejected during flotation sorting and monitor kernel quality. Record the amount of crop lost and the causes for crop loss to aid future management decisions. Crop loss protocols have been developed by NSW DPI (see 5.5 for reference).

4.4 Drying of nut-in-shell

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4.4.1 Recommendation – Monitor moisture content at harvest and then at least weekly during drying and daily if using heated air during drying.

Effective on-farm drying and storage of macadamias relies on knowing the moisture content of the kernel and/or the nut-in-shell during the process. A lack of understanding of the moisture content can result in ineffective drying and storage and a resulting deterioration in quality of the nuts.

Options for monitoring moisture content have been outlined in an article by Mary Collins. See 5.5 for reference.

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4.4.2 Recommendation – Remove excess free water from the surface of the nuts before adding them to a storage vessel.

Excess free water should be removed from the surface of the nuts, particularly following flotation grading, before being added to storage vessels. This will decrease the time required to dry the nuts and to reduce the wetting of nuts already in storage. This can be done by passing them over a trommel or by using fans.

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4.4.3 Recommendation - Commence drying immediately following dehusking and sorting or washing. Reduce nut-in-shell moisture content to 8 to 10% (or kernel moisture content to 4%) within two weeks of harvest.

It is important to reduce nut-in-shell moisture content to 8 to 10% within two weeks of harvest to prevent a deterioration of quality, particularly with regard to increases in mould, rancidity and other off-flavours and reduced shelf life. (NB This is not the optimum moisture content for water sorting.)

Nut-in-shell moisture content of 8-10% is approximately equal to a kernel moisture content of 4%. If this cannot be achieved using ambient air due to weather conditions, then heated air can be used provided adequate precautions are taken as per recommendation 4.4.4.

If the moisture content cannot be reduced to 10% within 14 days the nuts should be delivered to the processor as soon as possible.

Storage of nut-in-shell before drying can increase mould and rancidity. It is important that there is an adequate airflow if wet nuts are being added to storage to ensure effective drying can occur.

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4.4.4 Key recommendation - If heating is used during drying, do not use temperatures greater than 30ºC or more than 5ºC above ambient temperature. Regulate temperatures closely and ensure that secondary controlling systems are in place to act as a fail-safe should the primary temperature controller fail. It is important that heating systems meet all legal safeguard and installation requirements and be installed by a properly qualified person.

Excessive temperatures during drying, particularly with nuts with high moisture contents, can cause internal browning and discolouration of the kernel during roasting and reduced shelf life. It is also not necessary to use temperatures greater than 30ºC or 5ºC above ambient temperature to achieve effective drying.

Secondary controlling systems need to be in place as entire silos of nuts can be ruined should the primary temperature controller fail and overheating occurs. Great care is also required to reduce the risk of fire damage if using heating. Consult relevant authorities with regard to legal requirements before installing heating.

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4.4.5 Recommendation - Ensure drying and storage facilities maintain an even and adequate airflow. Fans should have controllers such as relative humidity testing equipment or time clocks with manual overrides. The bed depth in silos should not exceed 2.5 metres. The bed of nuts in the top of silos or bins should also be levelled to ensure that there is an even flow of air through the NIS. Consult silo/bin manufacturers to ensure the suitability of drying fans.

Uneven or inadequate airflow and ventilation causes increased mould, rancidity and germination and reduced shelf life. Adequate venting of silos is required to allow sufficient air movement equivalent to the air intake. Fan controllers such as relative humidity testing equipment or time clocks with manual overrides enable more efficient drying. It is difficult to maintain even, adequate drying with silo bed depths greater than 2.5m.

The following table and comments provide guidelines for capacities of drying fans suitable for nut-in-shell storage.

Table 1 On farm nut-in-shell storage guidelines

Silo diameter	Approx. Tonnes* @ 3m wall height	Minimum fan capacity in cubic metres/sec	Ideal fan capacity in cubic metres/sec	Ideal axial flow fan diameter	Ideal axial flow fan 3 phase motor size
2.5	9	1.473	2.210	750 mm	1.5 kw
3	13	2.121	3.182	800 mm	2.2 kw
3.5	18	2.887	4.331	800 mm	3 kw
4	24	3.771	5.657	900 mm	3 kw
4.5	31	4.773	7.160	900 mm	5.5 kw
5	38	5.893	8.839	900 mm	7.5 kw
5.5	46	7.130	10.695	1000 mm	11 kw
6	55	8.486	12.728	1000 mm	11 kw
6.5	64	9.959	14.938	1000 mm	15 kw

***Approximate NIS tonnage at 20% moisture content. The NIS tonnage at 10% moisture content will be less.**

Axial flow type fans are indicated here due to low cost and adaptability but they should be fitted with an attenuator to reduce noise pollution.

Farmers when considering fan capacity should look at farm operations such as climatic conditions, wet sorting equipment and silo filling rates. The use of fan controllers such as relative humidity testing equipment or at least time clocks with manual overrides are recommended for macadamia storage.

Source: Cooper, D.G. (2000) Suncoast Gold Macadamias (Aust)

4.5 Storage of nut-in-shell

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4.5.1 Recommendation – Ensure there is sufficient storage with forced airflow available to hold 50% of the crop. At least two storage vessels (eg silos/or bins) are preferred.

It is recommended that growers have sufficient storage capacity available to hold at least the nuts from the largest harvest round. On some farms, this can be up to 50% of the crop.

Two storage vessels enable you to dry wet nuts prior to sorting, and avoid adding wet nuts to already partly dry nuts. They also assist with regular complete emptying of silos to ensure nuts are not stored longer than necessary.

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Additional storage vessels increase the capacity to handle the harvested crop. This can be very important during peak harvest periods.

4.5.2 Recommendation - Completely empty storage vessels when consigning nuts or transferring nuts to other storage vessels.

Complete emptying of storage vessels is necessary to ensure that nuts are not stored longer than desirable, resulting in a deterioration of quality. If storage vessels are not completely emptied, old nuts will mix with new nuts when the new nuts are added.

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4.5.3 Recommendation - Do not use heating during storage once moisture content of nut-in-shell is 8 to 10% but continue to use fans with humidity control or time clocks.

It is important to maintain air circulation once the above moisture contents are reached but it is not necessary to use heating, as you do not want to over dry the nuts. The kernels will be more prone to fracturing during handling and transport if they are dried on farm to below the recommended levels.

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4.5.4 Key recommendation – Do not store NIS for longer than 4 weeks at moisture contents greater than 10%. Consign nuts at 8 to 10% nut-in-shell moisture content to the processor within four weeks of harvest.

Storage of nuts at moisture contents greater than 10% for 4 weeks or more at 25ºC can increase rancidity and off flavours and shortens shelf life. Lower moisture contents and lower storage temperatures are required for longer storage of nut-in-shell. The table below shows the time to significant loss in quality of raw or roasted macadamias at different storage temperatures.

If it is not possible for any reason to consign nuts within 4 weeks, nut-in-shell at 8 to 10% m.c. can be stored for up to four months at 5ºC or below.

There is also an increased risk of fracturing, chipping or bruising of the kernel during handling or transport at NIS moisture contents less than 8 to 10% m.c.

Table 2 Macadamia nut-in-shell storage

NIS moisture (%)	Storage temperature (ºC)	Shelf-life* (months)
15.0	25	0.5
	5	4.0
12.5	25	0.5
	5	4.0
10.0	25	0.5
	5	12.0
7.5	25	1.0
	5	12.0
3.5	25	12.0
	5	>12.0

Source: Kowitz, T.J. et al (1998)

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4.5.5 Recommendation - Avoid drop heights exceeding 2 m.

Excessive drop heights cause increased fracturing and bruising of kernels. As the nut-in-shell moisture content decreases, it is more prone to damage and the acceptable drop height decreases. The maximum acceptable drop height at 10% nut-in-shell moisture content is 2 metres. Effective letdown measures need to be in place for drop heights greater than 2 m.

4.6 Transport of nut-in-shell

NQ

4.6.1 Recommendation - Assess kernel quality before consigning nuts.

Assessing kernel quality before consigning is important in deciding whether:

- The nuts meet at least minimum standards to warrant consignment
- Further sorting of the nuts is required, or
- Further sorting is unlikely to raise the quality to at least minimum standards economically and the nuts should not be consigned.

NQ

4.6.2 Recommendation - Minimise the time in transit of the nuts to the processor once they have been removed from storage with air circulation.

Delivery delays can lead to a reduction in kernel quality and shelf life. At moisture contents above 10%, this reduction in kernel quality and shelf life is accelerated.

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4.6.3 Recommendation - Suitable precautions should be taken to prevent contamination of nut-in-shell during transit. The grower or another responsible person should inspect the transport before loading and ensure it is clean, particularly of animal waste or husk. Secure and cover loads for long distance travel.

Unclean containers increase the risk of contamination.

Failure to secure or cover loads can lead to contamination of the consignment by dirt, gravel, broken glass etc.

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4.6.4 Recommendation - Avoid drop heights greater than 2 m without effective letdown measures. Where possible, avoid uneven routes, rough handling and vehicles with excessive vibration.

Excessive drop heights cause increased bruising and fracturing of kernels. Rough road or vehicle conditions, or rough handling can also lead to increased fracturing.

NQ

4.6.5 Recommendation - Send *Macadamia tetraphylla* and *Macadamia integrifolia* nuts in separate consignments to the processor. Confirm with processors before consigning whether they will accept *M. tetraphylla* nuts. Check also with processors which hybrids or seedlings are acceptable before consigning.

Macadamia tetraphylla nuts have a higher sugar content which leads to excessive browning if they are roasted at temperatures suitable for *M. integrifolia*. The characteristics of hybrids vary across the range between the two species. Nut quality of seedlings is also variable.

NQ

4.6.6 Recommendation - Ensure adequate records are kept in order to complete processor delivery dockets. Ensure details on receival dockets are also correct.

Inadequate information to the processor can lead to inappropriate handling and processing of the consignment. Farm recording systems such as MacMan are designed to enable macadamia growers to quickly and easily keep adequate records to complete processor delivery docket requirements.

Section 5 Further reading

5.1 Food safety guides

Approved Supplier Manual, On-farm Macadamia quality and food Safety Management, Echman J. et al (2002) NSW DPI.

Codex Alimentarius volume D – recommended international code of hygienic practices for tree nuts Anon. (1972), FAO/WHO Codex Alimentarius Commission.

Developing an approved supplier program for fresh produce – a guide for customers and suppliers Ledger, S.N. et al (1999) Queensland Department of Primary Industries

5.2 Macadamia production guides

Macadamia Growers Handbook, O'Hare P. et al (2004), QDPI

Problem Solver and Bug Identifier, Gallagher et al (2003) QDPI

MacMan – a farm management system for macadamias (software, user's manual, diary and wall chart) Mulo, S. et al (1999) Queensland Department of Primary Industries

Growing macadamias in Australia O'Hare, P.J., Loebel, M.R. and Skinner I. (1996) Queensland Department of Primary Industries

Diseases and disorders of macadamias Fitzell, R.D. (1994) NSW Agriculture

Insect pests of macadamias in Queensland Ironside, D.A. (1981) Queensland Department of Primary Industries

Infopest pest management information system (compact disk) Anon (1999) Queensland Department of Primary Industries

Agrilink macadamia sorting guide (poster) Vock, N.T. et al (1999) Queensland Department of Primary Industries

Farm chemical user training program (user workbook and reference manual) Anon (1997) Farmcare Australia (NSW)

Efficient pesticide use in tree crops Battaglia, R. et al (1997) Queensland Department of Primary Industries

Pesticide application manual 2nd edition Banks, A. et al (1990)

New endosulfan regulations for horticultural crops (agnote) Hardy, S., (1999) New South Wales Agriculture

5.3 Articles on macadamia harvesting

The effect of harvest time and harvest method on the quality of macadamia nuts Mason, R.L., (1983) Food Technol. Aust. 35: 184-5

The effect of harvest interval on the quality of ground harvested macadamia nuts Mason, R.L. and Wells, I.A., (1984) Food Technol. Aust. 36: 273-8

5.4 Articles on nut development and maturity

Development and maturation of macadamia nuts in Australia McConchie, C.A. et al, (1996) Proceedings of the Australian Society of Horticultural Science Challenges for Horticulture in the Tropics 234-243

5.5 Articles on macadamia post-harvest handling

A review on the literature on farm drying and storage Atkinson, B., (1990) AMS News Bulletin 17(2): 12-15

Storage of macadamia nut-in-shell Kowitz, T.J., Mason, R.L., Bowden, R.P. and Isaacs, A.R. (1998) Horticultural Research & Development Corporation final report, HRDC project MC 607, HRDC, Sydney, Australia

Update on the use of mDhT aeration controllers in the drying of macadamia nuts Winks, R.G. (1999) AMS News Bulletin 26(1): 31-34

Ambient air temperature and relative humidity can limit the on farm drying of macadamia nut-in-shell Kowitz, T.J., Mason, R.L. and Young, G. (1998) AMS News Bulletin 25(4): 67-72
Development of a cleaning and sorting system for macadamia nut-in-shell Mason, R.L. et al (1996) Horticultural Research and Development Corporation final report, HRDC project MC 200, HRDC, Sydney, Australia
Moisture sorption characteristics of in-shell macadamia nuts Palipane, K.B. and Driscoll, R.H. (1992) J. Food Eng. 18: 63-76
Density, porosity and composition of macadamia in-shell nuts Palipane, K.B., Driscoll, R.H. and Srzednicki, G. (1992) Food Aust. 44: 276-80
Effect of drying temperature on chemical composition and quality of macadamia nuts Prickavudhi, K. and Yamomoto, H.Y. (1965) Food Technol. 19: 129-32
Determining Nut-In-Shell Moisture Content, Collins M. (2001). AMS News Bulletin 28 (3): 47-48
On Farm Macadamia Drying Using Humidity Meters, Wilkie J (2001) AMS New Bulletin 28 (3): 45-46.
Crop Loss Protocols

5.6 Sustainable management guides

Farmcare, cultivating a better future – code of practice for sustainable fruit and vegetable production in Queensland Anon (1998) Queensland Fruit and Vegetable Growers
Buffer Areas Anon (undated) Lismore City Council Development Control Plan No.27
Information for farmers –frequently asked questions (2000) National Registration Authority for Agricultural and Veterinary Chemicals

5.7 Workplace Health and Safety Guides

Workplace Health and Safety Manual for the Australian Macadamia Industry, 2003.
Noise Study for the Australian Macadamia Society (2003) Prepared by Noise and Sound Services.
Code of practice for the safe use and storage of chemicals (including pesticides and herbicides) in agriculture Anon (1998) WorkCover Authority of New South Wales
Code of practice for the safe use of pesticides including herbicides in non-agricultural workplaces Anon (1998) WorkCover Authority of New South Wales
Draft occupational health and safety regulation 2000 Anon (1999) WorkCover Authority of New South Wales
Health and safety checklist Keenan, W. (1999) WorkCover Authority of New South Wales
Code of practice for the storage and use of chemicals at rural workplaces Anon (1994) Queensland Department of Employment, Training and Industrial Relations, Division of Workplace Health and Safety
The rural plant industry code of practice Anon (1999) Queensland Department of Employment, Training and Industrial Relations, Division of Workplace Health and Safety
Rural employers' guide to introduce worker safety Anon (1999) Queensland Department of Employment, Training and Industrial Relations, Division of Workplace Health and Safety
Rural industry worker's guide Anon (1999) Queensland Department of Employment, Training and Industrial Relations, Division of Workplace Health and Safety

Safety link Anon (1999) Queensland Department of Employment, Training and Industrial Relations, Division of Workplace Health and Safety. This is a series of leaflets on rural workplace health and safety

5.8 Other reading

Further technical reading is available at the QDPI Maroochy Research Station, Mayers Road, Nambour and the NSW Agriculture Tropical Fruit Research Station, Bruxner Highway, Alstonville. The Australian Macadamia Society also has a web site and an electronic bulletin board that can be accessed by computer and modem.

Appendix 1

Recommended Minimum Standards for Macadamia Nut in Shell Offered to Processors

(From the Macadamia Industry Handbook – Minimum Standards and Guidelines)

PRODUCT DESCRIPTION

Macadamia nuts are derived from trees of the species *Macadamia integrifolia* and *Macadamia tetraphylla,* and their hybrids. Macadamia nuts in shell, delivered to the processor, shall consist of dehusked in-shell nuts. In-shell nuts shall be delivered in lots according to their species characteristics, with all smooth shell nuts consigned separately from rough shell nuts.

COMPOSITION AND QUALITY FACTORS

Lot requirements:	
• Live insects	Nil per lot
• Foreign matter[1]	Not more than 1% per lot
Nut in Shell requirements:	
• Moisture	Not greater than 12% by weight[3]
• Diameter at its shortest axis	Greater than 18 mm
• Dirt or other foreign material	Nil
• Surface moisture	Nil
• Damage caused by rodents, cracks[2], holes or punctures, surface mould, or other forms of damage	Nil
Kernel requirements:	
• Nut in shell should contain:	Fully mature[5], Sound Kernels[6].
• Recovered Sound Kernel should contain:	Greater than 90% by weight of First Grade Kernel[7]
• The weight of Unsound Kernel[4]	Should not exceed 3.5% by weight on a dried nut in shell basis.
Chemical residues[8] in recovered sound kernel	Shall not contain in excess of maximum residue limits as published in the Food Standards Code[9].

[1] *Foreign matter* is any material other than whole sound nut in shell greater than 18mm in diameter.
[2] *Crack* is defined as when open or exceeds one half the long axis of the nut in shell.
[3] Unless prior arrangements have been made with the processor.

Appendix 2

Recommended Minimum Standards for Macadamia Nut in Shell offered for Retail Sale

(From the Macadamia Industry Handbook – Minimum Standards and Guidelines**)**

PRODUCT DESCRIPTION

Macadamia nuts are derived from trees of the species *Macadamia integrifolia* and *Macadamia tetraphylla*, and their hybrids. Macadamia nuts in shell consist of dehusked in-shell nuts.

COMPOSITION AND QUALITY FACTORS

First or Premium Grade:

- Nut in shell shall be mature nuts
- Nut in shell should be uniform in appearance
- Insect or rodent damage Nil
- Cracks, holes or punctures, surface mould or other forms of damage or deterioration. Nil

Standard Grade:

- Nut in shell shall be as described in the standard for First or Premium Grade above, but may contain nut in shell of less even appearance as to colour, shape or slight damage, *e.g.* chipping, scratching or marking of the shell or hairline cracking.

Both First or Premium Grade and Standard Grade:

- Moisture Not greater than 10%
- Sound kernel Not less than 25%, of which not less than 90% shall be First Grade kernel.

However, **First or Premium Grade and Standard Grade** nut in shell shall pass the following test:

- When 10 nuts are selected at random, **NOT MORE THAN** 2 of these 10 shall contain unsound kernels.

SIZE GRADING[10]

- EXTRA LARGE: More than 28 mm diameter
- LARGE: Between 23 mm and 28 mm (25 mm average)
- MEDIUM: Between 18 mm and 23 mm (20 mm average)
- SMALL OR UNDERSIZED: Less than 18 mm diameter

SAMPLING AND EVALUATION METHODS

Methods used to establish the above criteria are those specified in *"Recommended standards for Sampling and Nut in Shell Evaluation"* (refer to *Appendix 2*) in the Macadamia Industry Handbook.

All pre-packaged nut in shell shall be clearly labelled to specify GRADE and QUANTITY and have the name of the grower and/or packer prominently displayed in accordance with Trade Measurement Packaging Legislation.

Nut in shell not complying with the descriptions above should be classified UNGRADED.

[4] *Unsound Kernel* is defined as kernel which is unsuitable for processing and/or sale as raw kernel due to the presence of insect damage, mould, *Unsound* decay, immaturity, discolouration, germination, or rancidity.
[5] Fully mature kernels are plump (unshrivelled), round, and firm.
[6] *Sound Kernel* is defined as fully matured kernel which is free from any insect damage, mould, decay, immaturity, discolouration, germination or rancidity. Sound kernel is suitable for roasting or sale as raw kernel.
[7] *First Grade Kernel* are those kernels (expressed as a percentage by weight) which float in tap water as described in *Recommended Standards for Sampling and Nut-In-Shell Evaluation*, AMS News Bulletin, (6), pp (1993).
[8] *Chemical Residues* are substances specified in Part A14 of the Food Standards Code, which includes residues of pesticides, weedicides, and fungicides.
[9] *Food Standards Code*, Australian New Zealand Food Authority (ANZFA), Section A14 - Residues in Food.
[10] Size grading shall be optional (at the discretion of the vendor). However it is recommended that there be four (4) grading as shown.