Nursery production of high-quality macadamia planting material and establishing an industry specification is recognised within Australia as playing an important role in supporting the Australian macadamia nut production industry. Purchasers of macadamia nursery stock require assurance that stock purchased meets an industry standard, is true-to-type, and that appropriate steps have been taken to reduce the chance of introduction of serious pests and diseases into the production environment.

Administration and auditing of the technical aspects for macadamia high-quality nursery production are now incorporated into the Nursery Industry Accreditation Scheme, Australia (NIASA) program. Macadamia best practice production requirements have been included into the 8th edition of the NIASA BMP Guidelines in the new Macadamia Nursery Stock Specification Appendix 15.

**Macadamia Nursery Stock Specification:**

The stamp of assurance that provides businesses with:

- A systematic approach for producing ‘superior’ macadamia planting material
- Consistent product quality meeting the industry standard
- Protection of the production environment from serious pests and pathogens
- Independent audits, guidance and technical support from GIA Auditors and Technical Officers

**The Macadamia Nursery Stock Specification**

The Macadamia Nursery Stock Specification (APPENDIX 15) in the 8th edition of the NIASA BMP Guidelines provide specialist guidance to macadamia production nurseries and allow an interested business to become NIASA accredited for meeting macadamia nursery production standards.

**What is NIASA?**

NIASA is the national nursery industry’s Best Management Practice (BMP) program for production nurseries, growing media manufacturers and greenlife markets. It is supported by the NIASA BMP Guidelines. Businesses may use the Guidelines as a reference or guidance document to improve their cropping systems without formal accreditation. HOWEVER, a business may also consider formal, annually externally audited, NIASA accreditation to demonstrate to customers that they meet industry best practice standards.

ALL auditable requirements within the Specification (see the audit checklist included within Appendix 15) must be found to have been implemented to at least a satisfactory standard for a business to be considered eligible to be granted accreditation against the specification.
It is important to note the following:

1. NIASA is a continual improvement program under the national framework of the Australian Plant Production Standard (APPS) which includes EcoHort and BioSecure HACCP programs.

2. The NIASA BMP Guidelines are a large document; HOWEVER, it provides best management practice guidance across several industry categories (production nurseries, growing media manufacturers and greenlife markets). For this reason, it is important to note that not all the content of the NIASA BMP Guidelines may apply to you – only relevant areas.

3. For macadamia nursery stock production, the key sections are Chapters 1 to 4 of the Guidelines - and its associated APPENDIX 5 (the nursery production checklist), APPENDIX 12 (Freight and logistics) and APPENDIX 15 (the Macadamia Nursery Stock Specification and its attached audit checklist).

4. Although a business may not necessarily be fully compliant in every area, a business may still be successful in gaining NIASA accreditation – should it be able to demonstrate to an auditor that there are steps being taken to make improvements in those areas. The exception to this are criteria highlighted in grey in the audit checklist. For these criteria, a business must be found to comply to these requirements to a satisfactory standard before receiving formal NIASA accreditation.

5. Businesses are audited against each auditable criteria using the checklists in the NIASA BMP Guidelines.

Application for NIASA Macadamia Nursery Stock Specification:

Complete and submit an application for NIASA accreditation form to GIA. Tick the appropriate checkboxes and complete the form in accordance with the instructions provided. To apply for NIASA, or for further enquiries on NIASA Macadamia Nursery Stock Specification accreditation please contact:

- email: biosecure@greenlifeindustry.com.au  Phone: (02) 8861 5100

Greenlife Industry Australia

Phone  (02) 8861 5100
Email  biosecure@greenlifeindustry.com.au
Extract from NIASA Best Management Practices Guidelines

APPENDIX 15 MACADAMIA NURSERY STOCK SPECIFICATION

A.15.1 Introduction
A.15.2 General production nursery requirements
  A.15.2.1 Water
  A.15.2.2 Growing media / propagating media
  A.15.2.3 Beds and benching
  A.15.2.4 Disinfestation and hygiene
A.15.3 Source materials to be used for propagation
  A.15.3.1 Source blocks
  A.15.3.2 Propagation material collection records
  A.15.3.3 Parent tree variety identification
A.15.4 Material collection and handling
  A.15.4.1 Seed nut
  A.15.4.2 Budwood
  A.15.4.3 Notes on Cuttings
A.15.5 Propagation

ACCREDITATION IN THE NURSERY INDUSTRY
CONTENTS

A.15.5.1 Sowing seed .................................................................................................................................................... 248
A.15.5.2 Transplanting / potting up seedlings into a final container ........................................................ 255
A.15.5.3 Grafting ............................................................................................................................................................. 258
A.15.5.4 Labelling of grafted trees .......................................................................................................................... 260
A.15.6 Plant health monitoring ........................................................................................................................................ 260
  A.15.6.1 Inspection and monitoring ....................................................................................................................... 260
  A.15.6.2 Inspection procedure - Above ground plant parts ......................................................................... 262
  A.15.6.3 Inspection procedure - Below ground plant parts (Sentinel trees)........................................... 264
  A.15.6.4 Maintaining records of inspection ......................................................................................................... 266
A.15.7 Pathogen testing ........................................................................................................................................................ 267
  A.15.7.1 NIASA approved testing laboratories ................................................................................................... 267
  A.15.7.2 Maintaining records of testing ................................................................................................................ 267
A.15.8 Product quality and meeting customer expectations ................................................................................. 267
A.15.9 Auditing for compliance and continual improvement................................................................................ 268
SCHEDULE 1: GROUP 1 and GROUP 2 PATHOGENS ................................................................................................. 271
SCHEDULE 2: EXAMPLE RECORD SHEETS ...................................................................................................................... 272
MACADAMIA NURSERY STOCK SPECIFICATION CHECKLIST ................................................................................ 276
APPENDIX 15 MACADAMIA NURSERY STOCK SPECIFICATION

A.15.1 Introduction

Nursery production of high-quality macadamia trees is recognised within Australia and abroad as playing an important role in supporting the macadamia nut production industry.

Purchasers of macadamia nursery stock require assurance that stock purchased meets an industry standard, is true to type, and that appropriate steps have been taken to reduce the chance of introduction of serious pathogens into the production environment.

In order for a production nursery to be eligible to be accredited as meeting the Macadamia Nursery Stock Specification, the production nursery must be:

- NIASA accredited; AND
- be found at audit to have implemented mandatory procedures (indicated through use of the term must) within this Appendix to a Satisfactory standard (see Section A.15.9 Auditing for compliance and continual improvement and the MACADAMIA NURSERY STOCK SPECIFICATION CHECKLIST).

A.15.2 General production nursery requirements

The production nursery must take steps to mitigate the risk of human assisted entry and spread of plant pathogens into and within the production area. High risk entry pathways include water, growing media, and contamination of production areas through movement of people and equipment.

A.15.2.1 Water

Irrigation water must be managed in accordance with the requirements provided in NIASA Section 1.1.1 Water.

Key requirements – Water

- Water that is obtained from town suppliers, bores free of surface run-off or clean roof catchments does not require disinfestation.
- Other sources of irrigation water (creeks, dams, rivers etc.) must be disinfested using an approved NIASA disinfestation procedure.
- Subsequent storage of disinfested/clean water requires facilities and procedures must be established and implemented that do not allow for contamination by untreated water, soil, plant debris, dust and animal movement.
- The pH and EC (Electrical Conductivity) of all water sources must be checked and recorded at least once per month as even town water supplies can have variations in quality.
- Water from surface supplies, springs, effluents, or water testing positive for the presence of root-rot organisms must be disinfested using a NIASA approved method.
A.15.2.2 Growing media / propagating media

Growing media must be managed in accordance with the requirements provided in NIASA Section 1.1.2 Growing media/propagating media.

Further information

- Production of macadamia trees occurs over a longer duration than most other nut/fruit trees – on average 12 to 24 months. As a result, it is important to ensure that high quality potting media is used to avoid breakdown of the media over this extended time period. The long time period also has the potential to cause problems in other areas such as nutrition and irrigation management.

- A good quality long lasting media designed for macadamias is essential if root health, and therefore tree health, is to be maintained. Of particular importance is air-filled porosity as this will decline over time as the media degrades.

Key requirements – Growing media / propagating media

- Growing media/propagating media that is sourced from a NIASA accredited growing media supplier does not require additional pathogen testing and treatment prior to use.

- Growing media/propagating media that is sourced from a non-NIASA accredited growing media supplier must undergo treatment or pathogen testing, and where pathogens are detected – treatment, prior to use.

- Growing media/propagating media prepared on-site which includes components that pose a risk of contamination, for example river sand, must be disinfested using an approved NIASA disinfection procedure.

- Each batch of growing media must be tested for EC (Electrical Conductivity) and pH using suitable equipment. Adequate records of all growing media must be maintained, including pH and EC.

- Growing media/propagating media must be stored in a manner to prevent contamination prior to use.

- Please also note APPENDIX 5 NIASA PRODUCTION NURSERY CHECKLIST SECTION 2: Growing media for a complete list of all audited criteria.

A.15.2.3 Beds and benching

Beds and benching must be managed in accordance with the requirements provided in NIASA Section 1.1.16 Beds and benching.

Key requirements – Beds and benching

- Ground level propagating beds. Beds must be totally isolated from soil (e.g. with the use of black plastic) and must be free draining. Beds must not be subject to flooding during periods of heavy rain.
- **Production beds for containerised stock.** The surface of the bed and the pathways adjacent to it must prevent contact of the plant, the plant roots or the container, with soil or water contaminated by soil (or growing media) or water draining from other containers or from any other possibly contaminated sources (e.g. road base). Pooling of water is not permitted.

  **Coarse gravel or crushed rock** covered surfaces must be well drained and the gravel aggregate (screenings of 10mm to 25mm diameter) must be a minimum of 75mm deep and preferably deeper.

  **Concrete, polythene or bitumen** is permitted where they are covering properly consolidated surfaces and exceptionally good drainage occurs, and all other hygiene practices are satisfactory. Beds with these surfaces must not pool water and must be separated as much as possible from adjacent production sites in terms of water runoff.

- Benches spanning or adjacent to either properly sealed or aggregate surfaced floors and paths need not be higher than 30cm. However, where splash and other methods of contamination are likely to occur, a suitable bench height is 75cm or higher.

- Please also note APPENDIX 5 NIASA PRODUCTION NURSERY CHECKLIST SECTION 3: Propagation for a complete list of all audited criteria.

---

**A.15.2.4 Disinfestation and hygiene**

To minimise the risk of movement of plant pathogens into and within the production area, disinfestation and hygiene procedures are paramount in any production nursery.

Hygiene means taking steps to prevent things from becoming contaminated where possible. Hygiene steps include avoiding contact of items with potentially infested surfaces, for example keeping hose nozzles and hand tools off the nursery floor.

Disinfestation, or sanitation, means removing contamination from potentially infested items. Chemical disinfectants or detergents and heat treatments are still the most reliable methods for the control of most plant pathogens. When preparing disinfectant or detergent solutions:

- Follow all label requirements and safety precautions when handling chemicals.
the root and if the suture line faces straight down the shoot will emerge and follow the curve of the nut around leading to a bend in the shoot. (see Image 6).

![Diagram showing suture line and micropyle](image6)

Image 6 – Effect of poor seed orientation. All of these seedlings are unsuitable for use. Courtesy of Chris Searle and Kim Wilson.

When placing the nuts in the sand bed they should be evenly spaced to prevent a nut that rots from contaminating nuts in close proximity and allows the seedlings to be removed from the sand bed with minimal damage.

**Further information**

- Spacing techniques may vary, however one method of ensuring nuts are evenly spaced is to purchase a piece of 40mm x 40mm weld mesh and press this into the sand before planting. Nuts are then placed evenly in the middle of each square. A 40 x 40mm grid will give a nut density of 400 nuts per square metre of sand bed.
Further Information

- There is some debate as to whether nuts should be placed just below the surface of the sand or at a maximum depth of 25mm above the seed surface. Placing the nuts at a depth of 25mm reduces the chance of them drying out as readily as nuts placed just below the surface.

- Planting the nuts at depths greater than 25mm above the seed surface is not recommended as this increases the germination time which may lead to more nuts rotting. It is also more difficult to remove the seedlings from the sand bed.

Managing the sand bed

The seed nuts in the bed should be kept damp but not wet.

Seed beds **must** be regularly checked for the presence of pest, disease and for weed growth (see Section A.15.6.1 Inspection and monitoring).

Further information

- The frequency of irrigation required will change with season and with daily weather. Nuts may be checked regularly by digging one or two up to check on the progress of germination and the how wet the nuts are.

- Watering the seed bed late in the afternoon in late autumn or winter may reduce seed bed temperature, through evaporative cooling, and lead to slower germination. A cool wet sand bed is also likely to be more conducive to pathogen development. Similarly, when the seedlings have emerged, they should not ‘go to bed’ wet at night as this may encourage pathogen development.

- When the seeds have germinated, consider keeping the surface of the sand cool as the emerging shoot tip is very delicate and easily damaged. Sand can easily heat up and retain enough heat to damage the shoot tips.
SCHEDULE 2: EXAMPLE RECORD SHEETS

The following recording sheets are examples of how the mandatory record keeping for NIASA can be achieved.

There is no requirement to use these sheets but they indicate the information that must be kept in accordance with the NIASA Macadamia Nursery Stock Specification.

Records must be made available to the Auditor when requested.

- Source Block Record - (Example)
- Propagation Material Collection Record – (Example)
- Crop Monitoring Record - (Example)
## Macadamia Nursery Stock Specification
### Source Block Record
#### Example Record

<table>
<thead>
<tr>
<th>Accredited Business (Name):</th>
<th>Source Block Address:</th>
<th>Source Block Reference (Name or Code):</th>
</tr>
</thead>
</table>

### SECTION A – Property Ownership Details

<table>
<thead>
<tr>
<th><strong>Owner name/business name:</strong></th>
<th><strong>Other details if applicable:</strong></th>
</tr>
</thead>
</table>

### SECTION B – Block Details

<table>
<thead>
<tr>
<th><strong>Date block record started:</strong></th>
<th><strong>Lot on Plan Number OR GPS coordinate at centre of block:</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Variety or varieties present:</strong></th>
<th><strong>Number of rows present in the block if more than one variety present:</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Map attached with block identified? □ Yes</td>
</tr>
</tbody>
</table>

### SECTION C – Variety identification

- **How is parent tree variety determined at or prior to material collection?**
  - □ Records are attached (genetic test results, varietal improvement program records, PBR etc.)
  - □ Examination of all or a combination of the following morphological trait/s below.
    - □ Tree shape
    - □ Leaf length
    - □ Husk shape
    - □ Tree size
    - □ Leaf width
    - □ Shell features
    - □ Tree density
    - □ Tip shape
    - □ Leaf spines

### SECTION D – Identification of trees where there is more than one variety present in the source block

- **Description of how parent trees to be harvested in a mixed block will be identified within the block (for example a tag placed on each tree, a row number and tree number in row, GPS or other method):**

### SECTION E – Any other comments
### Macadamia Nursery Stock Specification

**Propagation Material Collection Record**

**Example Record**

<table>
<thead>
<tr>
<th>Accredited Business (Name):</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Source Block Address:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Source Block Reference (Name or Code):</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Collection Details

<table>
<thead>
<tr>
<th>Date</th>
<th>Collector name:</th>
<th>Material type:</th>
<th>Variety</th>
<th>Amount:</th>
<th>Batch code:</th>
<th>Comments:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>☐ Seed nut</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>☐ Budwood/scion</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>☐ Seed nut</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>☐ Budwood/scion</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>☐ Seed nut</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>☐ Budwood/scion</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>☐ Seed nut</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>☐ Budwood/scion</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>☐ Seed nut</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>☐ Budwood/scion</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>☐ Seed nut</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>☐ Budwood/scion</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>☐ Seed nut</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>☐ Budwood/scion</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>☐ Seed nut</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>☐ Budwood/scion</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>☐ Seed nut</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>☐ Budwood/scion</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>☐ Seed nut</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>☐ Budwood/scion</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>☐ Seed nut</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>☐ Budwood/scion</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>☐ Seed nut</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>☐ Budwood/scion</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>☐ Seed nut</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>☐ Budwood/scion</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>☐ Seed nut</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>☐ Budwood/scion</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>☐ Seed nut</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>☐ Budwood/scion</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**APPENDIX 15 MACADAMIA NURSERY STOCK SPECIFICATION**

NIASA Best Management Practice Guidelines 8th edition 2019
CHECKLIST: Macadamia Nursery Stock Specification

Applicable to businesses seeking Macadamia Nursery Stock Specification accreditation in addition to meeting other NIASA production nursery accreditation requirements.

SOURCE MATERIALS TO BE USED FOR PROPAGATION

Source block records

A source block record is maintained that identifies the source/s of material used for propagation:

- Unique identification name or code
- Property address and owner
- Lot on Plan or GPS coordinate
- Block map
- Variety or varieties
- Variety confirmation records
- Method of identifying variety in mixed block
- Number of rows in the block (if mixed variety block)

Records must be sighted by the Auditor

Comments:

Propagation material collection records

A propagation material record is maintained that identifies material collection details from the source block:

- Source block name or code
- Collection date
- Type of material collected
- Variety
- Source of material identified for collection from variety in mixed block
- Unique batch code

Records must be sighted by the Auditor

Comments:
CHECKLIST: Macadamia Nursey Stock Specification Continued

MATERIAL COLLECTION AND HANDLING

<table>
<thead>
<tr>
<th>Seed nut</th>
<th>Needs Attention</th>
<th>Being Upgraded</th>
<th>Satisfactory</th>
<th>Complies Fully</th>
<th>Doesn’t Apply</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seed nut is stored under appropriate storage conditions</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stored seed nut batches are labelled to identify variety, block code, collection date and a unique batch code</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Batches of seed nut can be traced back to the propagation material collection record</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Comments:
____________________________________________________________________
____________________________________________________________________
____________________________________________________________________
____________________________________________________________________

<table>
<thead>
<tr>
<th>Budwood / scion material</th>
<th>Needs Attention</th>
<th>Being Upgraded</th>
<th>Satisfactory</th>
<th>Complies Fully</th>
<th>Doesn’t Apply</th>
</tr>
</thead>
<tbody>
<tr>
<td>Budwood has been girdled</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Material is stored under appropriate storage conditions</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stored material is labelled to identify variety, block code, collection date and a unique batch code</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Batches of material can be traced to the propagation material collection record</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Comments:
____________________________________________________________________
____________________________________________________________________
____________________________________________________________________
____________________________________________________________________