NURSERY PAPERS
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NURSERY TREE STOCK INSPECTION AND VERIFICATION PROCEDURE

SUMMARY

- Tree Stock Inspection Procedures assist production nurseries by establishing and maintaining nursery industry best practice
- Procedures ensure stock can be graded accurately, with reduced waste and therefore greater profitability
- The procedures outlined can be used to demonstrate to clients the implementation of rigorous production processes
- This nursery paper outlines the key steps to implementing inspection procedures and can be adopted by any production nursery.

BACKGROUND

Growers of good quality nursery tree stock recognise the importance of each step in the production process and how each step influences and impacts physiological structure, plant health and establishment. The ***NIASA Nursery Tree Stock Specification*** outlines the relevant criteria for nursery tree stock production. To implement these specifications, production nurseries should have internal processes and training in place that allows implementation and the demonstration of industry best practice.

This nursery paper is intended as a guide for production nurseries implementing internal inspection and verification procedures for the production of nursery tree stock.

Image: *Araucaria columnaris*, Benara Nurseries, Forrestdale Western Australia

GETTING STARTED

Procedures should be site specific and appropriate for the types of trees being produced. Initially, categorise each product line and identify steps in the production process. For example, if you grow local eucalypt species from seed and deciduous trees from hard wood cuttings, provide clear work instructions that describe the production techniques and methods used for both. It should be possible to trace each individual tree back to a batch or ID number which is used for each step of the process. All staff completing inspections should have access to written or visual procedures that demonstrate the standards required. These may be provided electronically, hard copy, printed then laminated in the work area and/or used for on-site inductions and on-going training.

Trees should be inspected during each stage of production, not just before despatch, and results recorded for tracking and information purposes.

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TREE STOCK INSPECTIONS – FIVE STAGES OF PRODUCTION:

1. **Propagation –** for stock grown in-house from seed, cuttings, budding or grafting.
2. **Importation –** trees purchased as seedlings and/or bare root stock, containerised, then grown on.
3. **Transplanting/repotting (staging) –** putting stock into larger container sizes at various stages.
4. **Growing on/hardening off –** until trees reach the desired size for sale or staging.
5. **Despatch –** final check to ensure stock meets client and industry specifications.

1. PROPAGATION – WHERE IT ALL BEGINS

For in-house propagation, ensure accurate records are kept that include details on location of trees from which seed or cutting material was collected, supplier, import conditions, provenance, date and any actions required. Clients may have a specific requirement, if an agreement is in place, link that record to the batch ID. Propagation records should include an accurate description of species, variety, cultivar, etc.

Containers selected must be appropriate for the tree type, for example – plugs, raised cell trays or tubes and air pruning crates. Alternatively, air pruning may start at the propagation stage by direct seeding into air pruning containers then thinning out if necessary.

In circumstances where seed germinates better in open trays, seedlings must be transplanted with care, at the optimal time, to avoid bending or damaging the tap root.

Tree Stock Inspection - Propagation

Grade A (best quality)	No tag				
Grade B (needs work)	Blue tag				
Grade C (reject)	Red tag				
Date propagated: 12.9.2020					
Inspection date: 19.10.2020					
Name: Nadia Gabellone					
Batch no: R8345					
Species/Variety/Cultivar: *Eucalyptus scoparia*					
Location: Prop house 2					
Total no. sampled: 10 out of 200					
No. tagged: 0					
Note: remove plants from containers/cells for visual root inspection					
	% strike	Growth	J roots	Roots	Comment
Cuttings	N/A	N/A	N/A	N/A	
	Approx % germ.	Growth	J roots	Roots	
Seed	90	10cm	Nil	Healthy	
	Bud	Graft	Stock	Scion	
Budding/grafting	N/A	N/A	N/A	N/A	
	Pest	Disease	Weed	Other	
Pests, diseases and weeds	Nil	Nil	Flickweed	Nil	Minimal, weeds removed
Action/comment	Inspect again 2/11				

Figure 1: Example of 'Tree Stock Inspection – Propagation' form. This is an example of information that may be recorded as part of the quality control process. Businesses can choose whether to complete separate records for each propagation stage or combine these criteria in one form. Fields required will vary depending on propagation methods used. *Source: Greenlife Industry Australia.*

If J roots are visible on inspection, before the transplanting stage, these trees must be pruned or culled as this will be detrimental to future growth.

Where possible include images within procedure documents to demonstrate the activity. For example – cutting preparation, callousing, early root development, etc. Diagrams can be very useful to demonstrate grading of cuttings and may show the length, thickness and trimming required. Inspect each batch before progressing to the next production phase and record the results and any actions required.

The following table is an example of criteria that may be included in a tree stock inspection in the propagation phase. Monitoring growth at this early stage will assist with production scheduling, the planning of maintenance tasks and grading to cull sub-standard tree seedlings. Record seed germination and strike rates of cuttings if you wish to obtain data that demonstrates the effect of different variables on plant growth. For example – cold storage, chill factor, production area temperatures, timing of cutting material collection, seed source and plant hormones.

2. IMPORTATION

When trees are purchased as containerised seedlings, or bare root stock, they should be inspected to ensure each batch meets the required standards, reject stock that fails. Keep incoming stock isolated, away from existing crops, until it has been inspected for pests, diseases, and weeds. In addition, check root quality and form just as you would for stock grown in-house. Stock which fails inspection should be rejected.

Image: Seed germination week 4.

Suppliers should provide a batch or ID number for incoming stock so the material can be traced back to its source. This number can also be used as a reference for stock that has been rejected because of defects. Seedlings or bare-root trees with known defects should not be on-sold.

Roots of bare rooted trees must not be allowed to dry out. Include processes for storage and treatment of imported stock in your internal procedures as a guide for nursery staff. When using cold storage for cutting material, clean, disinfest and test temperature in the cold room well in advance of the expected delivery date.

3. TRANSPLANTING AND STAGING

In nature roots extend beyond the branch tips or drip line. Growing trees in containers can be problematic as roots can circle in the container or hit the sides of hard wall containers inhibiting development of roots growing radially away from the trunk. Air pruning containers increase root branching and can significantly reduce the risk of circling roots, roots that are deflected downwards and roots that are matted at the base. Trees should be root pruned each time they are

staged into a larger container size. This will encourage root branching which improves structural stability and greatly increases the tree's capacity to take up nutrients and water when planted in the landscape.

Whilst air pruning reduces the risk of root defects it does not eliminate the problem. Make sure landscape trees in containers under 45L are staged at least once and trees in containers above 45L in size at point-of-sale have been staged multiple times. Regardless of the container used, root systems must be inspected before or during each staging activity. An air compressor can be useful to inspect root systems closely without causing damage. Correcting defects becomes harder as roots grow larger and so preventative maintenance is key.

To reduce or eliminate root defects:

- Inspect root systems each time trees are staged and correct or cull defects.
- Prune roots to encourage side growth and prevent circling and/or matting.

Image: Root growth comparison of a tree seedling in a hard walled container (left) and one grown in a S1020 (right)

Image: Large roots growing around the outer edge of the root ball. Has been in the container too long, University of Florida.

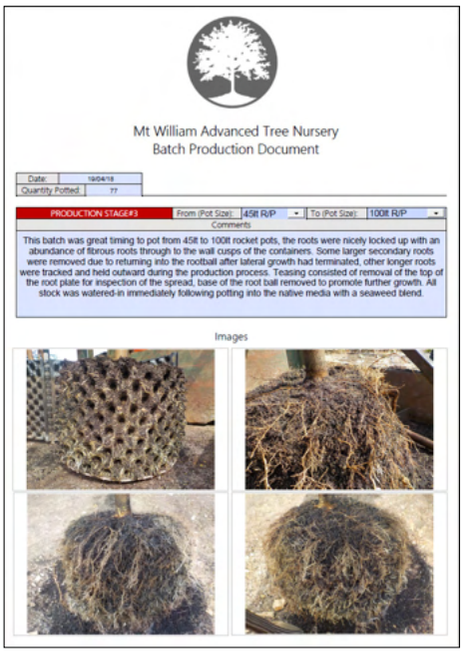

Figure 2.

- Use an appropriate container for the size of root ball in proportion to above ground growth.

Root pruning can be done using secateurs, a hand saw or electric saw. Make cuts down the side of the root ball to encourage root branching, if matting is solid on the outside of the root ball the outer layer should be shaved off. Matting at the base must be removed and if the tree has been in a square shaped container take the upper outer corners off before planting into a cylindrical container or bag.

To enable the container to capture water, leave a gap between the top of the container and the growing media (approx. 5cm for a 45L container). When trees are actively growing, fresh, light coloured roots should be visible when the plant is removed from the container. When placing trees in a larger container it is very important to ensure that the base of the trunk sits level with the new layer of growing media or substrate, allow for growing media to settle as trees are watered in.

Above ground pruning and weed prevention should be addressed as part of the same process. If dieback is present, ensure affected stems are removed using clean, disinfested and sharp tools. If there are obvious issues with tree shape or form address this by pruning each batch before transportation to the growing area.

Similarly, stock may need to be staked, taped, or labelled. Apply pre-emergent herbicide or barriers e.g., coir mats, to reduce the likelihood of future weed outbreaks and apply fertiliser if it is not contained in the growing media. During winter, whilst there is an absence of foliage on deciduous tree stock, check that branch buds are healthy. Trees should be thoroughly watered in as soon as possible after staging is completed.

4. GROWING ON AND HARDENING OFF

Formative pruning, if required, is critical for some species, such as *Eucalyptus spp*. during the growing on phase while tree stems are malleable. Some trees do not require significant intervention to maintain shape whereas others will need training to develop a central leader and achieve landscape standard. Regular inspections can assist in scheduling maintenance to avoid common problems.

Growth habits will vary greatly depending on the tree type, so it is important to know which pruning techniques to use and train staff accordingly. Formative pruning includes procedures like training a dominant central leader, balancing out lopsided growth, removing epicormic growth, bark inclusion and reducing or removing co-dominant stems. Essentially, formative pruning often reduces the need for corrective pruning later.

Images: This tree was grown then planted in the landscape with a defect (bark and poor structure). Corrective pruning was carried out, however this is far from ideal as large wounds increase the risk of stress, fungal disease and bacterial infections.

Removing lower branches too soon can lead to a reduced calliper of the main stem so generally the central leader is taped to a stake until the desired calliper is achieved and the trunk is strong enough for the stake to be removed and support the weight of the branches.

Keep in mind that pruning cuts take time to heal. Above ground growth must also be self-supporting at the point of despatch. Trees need to be 'hardened off' or acclimatised to the outdoor environment before despatch. During the growing on period observe general tree health and nutrition, for example – yellowing leaves, chlorosis or nitrogen deficiency, to allow enough time for any issues to be addressed before despatch.

5. DESPATCH

Despatch should be the final check point to ensure that nursery tree stock meets the specification before delivery. For this step ensure that the inspection covers the full range of criteria and record the calliper and tree height. Specimens should show good form, be self-supporting, centred in the container, have an intact root ball and a strong root system. Growers should also be aware of their general biosecurity duty and not knowingly transport or despatch plants with pests and/or diseases present.

Photos are a useful way to document plant quality and can then be used to demonstrate stock that can be grown to order. Having systems in place to inspect trees will greatly reduce the risk of possible defects. If a customer chooses to accept tree stock that has obvious defects, or falls outside the normal parameters of a specification, this should be reflected in the records that are signed by the customer on pick up or delivery. The following form (see right) is an example of criteria that may be considered when staff are inspecting trees being grown on or despatched.

Tree Stock Inspection - Growing on and Despatch					
Grade A (best quality)	No tag	Label only			
Grade B (needs work)	Blue tag				
Grade C (reject)	Red tag				
Inspection Date: 11.11.2020					
Name: Bob					
Location: Despatch area					
Batch no: S5483					
Species/Variety/Cultivar: Pyrus calleryana 'Capital'					
Container: 45L					
Date of last potting/root division: 1.7.2020					
Total no. sampled: Above ground x 60 (100% of order), root system x 2					
No. tagged: 1					
Notes: 1. Containers must be removed for visual root inspection. 2. 90% + of the rootball should remain intact when removed from the container. 3. Rootballs in containers 45L or greater should have a diameter greater than their depth.					
	Depth/width	Root Crown	J roots	Circling	**Comment**
Root system	40 x 40	OK	Nil	Nil	
	Roots	Shoots	Formative	Damage or die back	
Pruning required	Nil	OK	N/A	Nil	
	Trunk centered in pot +/- 10%?	Angle in container	Trunk no more than 15 degrees deviation from centre	Self supporting	
Position	YES	OK	OK	YES	
	Crown Form	Crown Cover	Crown Density	Leaf/bud colour and size	
Health/shape	OK	OK	OK	OK	
	Height	**Calliper**	**Stem/branch diameter ratio**	**Leader apical bud intact**	
Note:	Decurrent (multi-stemmed, weeping or shrub like) stock should have terminal buds intact				
Proportion	1.5M	6cm	OK	59 out of 60 OK	1 is without a central leader
	Sound/strong	**Stock/scion diameter 80%+ compatible**	**Rootstock shooting below graft**	**Scion true to type**	
Grafts	YES	YES	NO	YES	
	Pest	Disease	Weed	Other	
Pests, diseases and weeds	Nil	Nil	Nil	N/A	
	Labelled	**Staked**	**True to type**	**Meets clients spec. i.e. min 1.5m tall**	
General	YES	NO	YES	YES	
Glossary	See reverse of page for full list of definitions				
Action required:	Tag and take tree without leader back to growing area for pruning. Replace with stock from batch S9736				

Figure 3: An example of criteria that may be included for inspections carried out during the growing on or despatch phase. Managers should determine the number of inspections required based on the production schedule, market requirements and the tree type. Processes also need to be in place for trees that do not meet specifications including follow up actions and communication with the client. *Source: Greenlife Industry Australia.*

LINKS AND FURTHER RESOURCES:

- NIASA Nursery Tree Stock Specification – download here: ***https://nurseryproductionfms.com.au/download/niasa-landscape-tree-stock-specification-preview/***
- For NIASA accreditation enquiries please email: ***biosecure@greenlifeindustry.com.au***
- Formative pruning information and diagrams: ***http://www.urbantree.org/prunehome.shtml***
- Tree Costing Tool: ***https://nurseryproductionfms.com.au/download/hort-innovation-tree-costing-tool/***
- Pestid Tool: ***http://pestid.com.au/***