Technical
Nursery Papers

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One of the most rewarding processes in nursery production is plant propagation. However, the opportunity for pest and diseases to severely impact on propagation success should not be underestimated. Poor hygiene in plant propagation can lead to complete propagation failure or retardation in plant growth, both of which have significant cost implications.

This *Nursery Paper* highlights hygiene protocols that should be implemented during the four stages of propagation:

- Cutting material and seed collection
- Cutting preparation
- Propagating
- Hardening off.

By improving your plant propagation hygiene standards, you can increase production efficiency and minimise endemic problems within the nursery.

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Hygiene in plant propagation

Many production nurseries fail to regularly review hygiene standards and as a result underlying and insidious problems are not obvious until it is too late. Hygiene problems in propagation can easily affect plants for their entire life. Preventing the spread of plant pathogens results in fewer pest and/or disease problems and a reduced need for using pesticides.

Many diseases, once established, are usually a source of on-going problems within a nursery. They are often difficult to eradicate because they reside in soil, on nursery surfaces, equipment, in water or on alternate hosts from which they can spread and re-infect new nursery plants. Nursery operators need to regularly review their hygiene protocols, as practices and infrastructure can slowly deteriorate.

Hygiene matters in all stages of propagation. It may be easier to review your hygiene standards within the four stages of propagation. Compare your current standards and protocol with the following:

Cutting and seed collection

- Use purpose built stock beds or plants in pots – not random plants
- Ensure stock plants are well fed, watered and free from pests and disease
- Take material from the middle or upper part of stock plants. Do not take from lower parts that might receive splash or come into contact with the ground

Managing stock plants to ensure health and hygiene can significantly improve propagation success. Clean stock plants and weedmats are used to reduce weeds, pest and disease populations at *Engall's Nursery*, NSW.

- Collect early in the day or in the evening to reduce plant stress
- Use clean secateurs and disinfect between plants – a plastic bottle with a 70% methylated spirits solution works well.
- When collecting propagation material, use new, clean, tagged and separate bags/containers for each variety.
- Always ensure you are clean before returning to the nursery if you go off site to collect material. This includes clothes and, in particular, footwear and tools.

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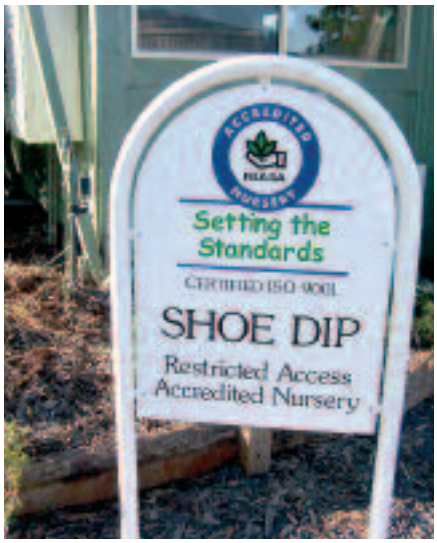
Cutting/grafting preparation

- Ensure hands are clean, wear an apron and latex gloves
- Use clean and disinfected secateurs, cutting tools and containers
- Surface sterilise cutting material (if required)
- Clean and disinfect the tool holders (eg. Pouches or containers)
- De-cant cutting hormone or powder into a smaller container so you can throw it away when finished with a batch
- Disinfect tools between batches or regularly if large batches – a plastic bottle with a 70% methylated spirits solution works well.
- Clean and sterilise benches and other working surfaces before and after use
- Use only clean, healthy and disease free material
- If required, drench with a fungicide or another steriliser.

Propagating

- Use only new, premium grade propagating mix that is known to have been prepared and stored hygienically, such as from an accredited growing media supplier.
- Use new trays/pots or tubes. If you must re-use then ensure they are sterilised properly, washing alone is not adequate.
- If dibbling – use a clean and disinfected dibbling stick.
- Ensure the propagating area is free from weeds, liverwort and moss.
- Ensure the propagating area is free from pests and diseases.
- Do not over wet propagating material and promote air movement.
- Restrict access to essential personnel only.

Ensure all working surfaces and propagation tools are regularly disinfected. A plastic bottle with a 70% methylated spirits solution works well. *Cameron's Nursery*, NSW.



Restricting access to essential personnel only is an important aspect of maintaining propagation hygiene. *Proteaflora Nursery Pty Ltd,* VIC.

Hardening off, potting and tubing up

- Use growing media that is known to have been prepared and stored hygienically, such as from an accredited growing media supplier.
- Use clean trays/pots or tubes. If you must re-use then you must sterilise them properly. Washing alone is not adequate.
- Ensure the hardening off, potting and tubing up areas are free from weeds, liverwort and moss.
- Ensure the hardening off, potting and tubing up areas are free from pests and diseases.
- Do not over water and promote air movement
- Restrict access to essential personnel only
- Keep batches separated.

Propagation benches and working surfaces need to be made of non-porous material so they can be easily disinfected between batches. *Mansfield's Propagation Nursery,* VIC.

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Table 1 Effective treatment for disinfection of common nursery surfaces from a range of plant pathogens.
All treatments applied as spray (160ml/m2). Concentrations are in ppm active ingredient (a.i.)

Surface	Fungi	Fungi	Bacteria	Nematodes
	Phytophthora cinnamomi	*Chalara elegans*	*Xanthomonas campestris*	*Meloidogyne* spp+
Capillary mat	2,000ppm Cl for 1h* 2,000ppm QAT for 1h*	None of the tested treatments were effective	2,000ppm Cl for 20 min 2,000ppm QAT for 20 min	4,000ppm QAT for 1h 20,000ppm Cu for 1h
Sand bed	2,000ppm Cl for 1h* 2,000ppm QAT for 1h* 20,000ppm Cu for 1h*	2,000ppm Cl for 24h	2,000ppm Cl for 20 min 4,000ppm Cl for 5 min	4,000ppm QAT for 20 min
Gravel	4,000ppm Cl for 20 min 20,000ppm Cu for >5h*	None of the tested treatments were effective	4,000ppm Cl for 20 min	4,000ppm Cl for 1h 2,000ppm QAT for 1h
Cement/ cement sheet	4,000ppm QAT for 1h 20,000ppm Cu for >5h*	None of the tested treatments were effective	4,000ppm Cl for 1h	Not tested

* Complete kill at lowest rate and time tested

\+ Meloidogyne spp were free-swimming juveniles. The adult female forms a more chemically resistant cyst which will be harder to kill with the listed treatments

Cl Chlorine solution (Sodium hypochlorite)

QAT quaternary ammonium compound. The test product was PHYTOCLEAN TM which contains 100g/litre benzalkonium chloride.

Cu copper either as copper oxychloride (used on Phytophthora and Chalara) or copper ethanolmine complex.

Source; *Nursery Paper* 'Hygiene in the Nursery', Issue No 2000/05

Benches and other working surfaces

One of the most fundamental requirements for healthy propagation is the cleaning and sterilisation of benches and other working surfaces between crops or batches. This must be done religiously, regularly and properly, which means cleaning first and then sterilising.

As a result, benches and other working surfaces need to be made of an easily disinfected surface, for example stainless steel or laminate. Timber and other porous surfaces cannot be sterilised properly, however, covering them in a plastic sheet can help maintain hygiene standards.

Floors and pathways

Always keep floors and pathways clean and weed free. Moss and liverwort should be constantly removed.

Concrete floors and pathways may incur a high initial outlay, but maintenance costs are minimal. Weed mat or plastic over gravel may incur a lower initial outlay than concrete, but can result in significantly higher maintenance costs.

Table 2 Suggested Disinfestation Protocols

Knives and other cutting instruments	
Step 1	Scrub clean using plastic 'scratchies' and 2,000ppm QAT solution, (make sure no dried sap remains),
Step 2	Dip cutting surfaces in fresh 2% sodium hypochlorite solution for 1 minute,
Step 3	Rinse in clean disinfected water to remove excess chemical (a squirt bottle may be useful).
Plastic containers and trays	
Step 1	Scrub clean using 2,000ppm QAT solution to remove media and plant debris,
Step 2	Dip in fresh 1% sodium hypochlorite solution for 20 minutes. or Steam-treat at 60ºC/30 minutes.
Hands	
Option 1	Use disposable gloves and change them between operations
Option 2	Wash hands thoroughly between operations using Savlon of Dettol soap
Wooden stakes and similar materials	
Heat treatment (60ºC/30 minutes) materials must be well separated. There are no effective alternatives.	
Footwear	
Option 1	Change footwear and use only designated footwear in the working area.
Option 2	Scrub clean with a brush and 2,000ppm QAT solution for at least 30 sec.
Tools, spades, bobcat buckets etc:	
Option 1	Scrub clean with a brush and 2,000ppm QAT solution
Option 2	Pressure clean with a 2,000ppm QAT solution

QAT = quaternary ammonium compounds

Source: *Nursery Paper* New hygiene protocols will reduce disease and save on control costs!, Issue No 1997/010

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Management and procedures

Even the best propagation infrastructure can quickly become unhygienic with poor management or lax procedures. Some basic tips are:

- Turnover stock plants regularly to ensure high health and 'vigour'.
- If you are using re-cycled or surface water, ensure the water is thoroughly disinfected.
- Use only freshly made disinfectant solutions of recommended concentration.
- Some liquids used for sterilising need to be stored at particular temperatures or in certain conditions (eg dark places) – read manufacturers instructions.
- Personal hygiene is important – always wash hands before and after eating, smoking and using the bathroom.
- All nursery staff need to have a 'hygiene' state of mind. They should be thinking about hygiene all the time and aware of protocols and procedures.
- Put hygiene signs and soap dispensers around – everywhere. A hand basin in the propagation area is recommended.
- The Nursery Industry Accreditation Scheme, Australia (NIASA) Best Management Practice Guidelines should be your bible. Read your bible!
- Throw out old, dead or ailing stock, they are not worth persevering with.

Maintaining hygienic facilities

- Footbaths work! Don't be scared to use them and replenish the solution regularly.
- Air movement fans can help to eliminate conditions favourable to disease.
- Do not propagate in the lunchroom or chemical store. Propagation requires a separate area that can be isolated with restricted access.
- Ensure pots, trays and tubes are stored up off the ground. If they must be kept outside, keep them in the original packaging or cover them.
- Keep propagation mix in original bags or fully covered in a storage bay. Only keep as much mix on hand as you need.
- Windbreaks help to reduce weed seeds and insects being blow in.
- Help your neighbours control weeds and pests.
- Keep hose ends and nozzles up off the ground.
- Repair holes in greenhouses, immediately!

Providing wash stations for staff will help to maintain cleanliness and encourage a 'hygienic' state. *Proteaflora Nursery Pty Ltd*, VIC.

Pests and diseases

Weeds in and around propagation areas can provide a breeding, hiding or over-wintering place for pests and diseases. Also, debris and poor maintenance can provide areas for pest and diseases to proliferate.

Be aware that humans and vehicles do transport pest and disease organisms, especially on things like muddy boots, woollen socks, yellow clothing, tractors and equipment, etc. As a result, regular scouting for pest and disease symptoms is an imperative first step for effective control. And keeping records of all pest and disease outbreaks and actions taken will provide valuable reference information.

Quarantine

Ensure any plant material brought onto the nursery is quarantined until it is certain no pest or disease threat exists. Keeping records of plant movements is crucial to provide an audit trial and track potential pest and disease sources.

Remember, prevention is always better than cure!

Further information

Nursery Paper 2000/05 – Hygiene in the nursery – Disinfecting production surfaces; cement, gravel, capillary mats and sand beds

Nursery Paper 2000/03 – Hygiene and sanitation of working surfaces in the nursery

Nursery Paper 1997/010 – New hygiene protocols will reduce disease and save on control costs

Nursery Industry Accreditation Scheme, Australia (NIASA) – Best Management Practice Guidelines. NGIA 2003

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