

Preventing disease in production nursery propagation areas



All reputable nurseries will agree that their major aim is to provide customers with plants of a high horticultural standard whilst using safe production practices. Production must be dependable and largely free from unpredictable failures due to diseases, insects and non-pathogenic disorders. Preventing diseases and insects from entering a nursery is not easy, but it can be minimised when the nursery manager is aware of the diseases and insects that are likely to impact the particular crop. A knowledge of specific sources of contamination is also required, so that nursery practices can be modified to reduce risk.

Plant pathogens can enter a planting in untreated irrigation water, infested soil and growing media, vegetative material (scions, buds, cuttings, tubers, bulbs and seed), contaminated containers, tools, clothes and shoes of visitors/workers, insects and by wind dispersal. Some diseases affecting plants in the nursery exhibit symptoms that are very apparent; others have symptoms that are hardly visible. Plantings should be monitored regularly so that any disease or pest outbreak can be treated appropriately and as quickly as possible to reduce spread. In other words, focus on finding the first case and remove it. At this time a knowledge of the source of the pathogen, its transmission, and potential for spread, will be invaluable.

This fact sheet contains information to assist growers to recognise specific sources of contamination and how to manage the risk of infestation. Growers are reminded that a single control measure is rarely sufficient to manage a plant disease. A proactive, holistic approach to managing plant health is required. Other resources may also assist and are found at the end of this document.

MOTHER (NUCLEAR) STOCK PRODUCTION ON-SITE

This section provides best practice recommendations for managing mother stock plants to reduce problems in producing propagules. Cuttings taken from mother stock that are grown under optimal conditions are more likely to be vigorous, have greater strike rate, are less prone to pest damage and less likely to have diseases present. Ultimately, healthy mother stock provides the best start in producing high quality saleable stock. For this reason, it is important to understand the conditions that mother stock plants have been grown (regardless of who has grown them).

Mother stock infected with plant pests (insects and pathogens) are likely to have increased management costs and can lead to crop failure. It may also lead to the spread of pests and crop loss for your clients.

The following recommendations will assist growers in managing mother stock optimally.

1. Grow mother stock in a **production area devoted to producing mother stock**, preferably on-site. If possible, grow in containers on raised benches.
2. Grow mother stock under **optimal conditions to avoid stress** by drought, nutrient deficiency, waterlogging, temperature extremes and other non-pathogenic disorders.
3. **Document your strategy** in a simple [management plan](#). Schedule pesticides (leading up to periods of high pest pressure), fertiliser, repotting etc to reduce crop stress.
4. **Monitor plant health regularly**. Early detection of pests, diseases and disorders reduces crop loss and management costs. Monitor root health regularly; root pathogens can be active for a long time without impacting above ground symptoms. Devote greater monitoring effort leading up to when cuttings will be taken; allow for sufficient time to make remedial actions if required.
5. **Never propagate from mother stock with pests or diseases**. Propagating from plants that have small numbers of scale insects, broad mites and other small pests can multiply the pest at the same time as the plant. This turns a small problem into a much larger one. Insects may also transmit viruses causing further problems and stock loss.
6. **Submit plants with suspicious symptoms to a diagnostic laboratory**. Send plants for testing even if you think you know what is wrong with them. Confirmation of the causal agent will give you the best chance to reduce losses,
7. **Be aware of symptomless, infected mother stock**. There are a wide range of pathogens that can be present in mother stock plants without causing symptoms. These are called [latent pathogens](#). Such infection may still cause cutting failure or may lead to crop loss after sale. For example, plants infected with vascular wilts (e.g. Fusarium wilt) may not show symptoms until the disease has progressed significantly. Cuttings taken from symptomless, infected mother plants may have high cutting failure. A number of industries have a certification scheme to show their stock are free of pathogens, e.g. citrus and avocado.
8. **Quarantine mother stock purchased from other businesses**. Ensure that purchased mother stock are healthy, vigorous and free of pests and diseases. The amount of time spent in quarantine will depend on the suite of high-risk pests and diseases of that plant and other practical considerations.
9. **Manage outsourced mother stock proactively**. It is sometimes necessary to contract other businesses to manage your mother stock plants. Build a strong and transparent relationship with this business. Discuss how you would like mother stock to be managed; include as much detail as possible, e.g. inputs such as pesticides, fertiliser, water and media requirements. It is recommended to build into the contract/relationship a facility to monitor their records of plant health, water quality, etc., such that you can be certain plants have been grown under optimal conditions.



Examine root health regularly. If there is an above ground health problem, wash roots to observe root structure and better observe root rot (which sometimes is only visible after washing).

allow for improved proactive management and the protection of healthy stock.

The mother stock may have to be sprayed regularly with pesticides to protect the plant from pathogens (especially those that cause latent infections) and insects. Do not [collect graft material](#) or take cuttings when plants are wet (from rain or irrigation) and avoid taking them during high heat and strong winds. Disinfect secateurs with 1% chlorine solution for 30 seconds when moving between plants. Do not allow the propagation material to come in contact with soil or growing media and use new, clean bags/containers for collection.

Regular inspections of the bark are also recommended for woody ornamentals and horticultural and forestry trees. The bark of these trees is not just a corky protective covering. It also contains two vital tissues. The innermost layer, the phloem, is important for the transport of nutrients (sugars, proteins, amino acids). Between the phloem and the cork are cortical cells, which are a major food storage tissue of the tree. Surplus food manufactured in the leaves during spring and summer is stored in these cortical cells. If the outer bark is punctured by bark beetles or is mechanically fractured, certain fungi (e.g. those from the family Botryosphaeriaceae) may enter to feed on the rich food bank of the cortical cells. Taking propagation material from such trees is high risk as it may lead to graft failure, or increased disease incidence in stressed trees, even years after leaving the nursery.

Damaged roots or stems close to the soil surface induce a wound response (which may involve a visible ooze or gummosis). This response can be used by certain pathogens to swim towards the wound, e.g. *Phytophthora* and *Pythium*. The strength of the response varies between plants and varieties and can be involved in host susceptibility. For some crops, infected plants may appear healthy or have symptoms that are easily misdiagnosed (e.g. appear similar to sunburn, slight nutrient deficiency etc). Such plants may die prematurely.

SEED

Seed can be a source of contamination that requires serious attention. Seedborne pathogens cause disease by reducing the viability of seed or by infecting seedlings after germination to cause damping-off, as well as diseases at various stages of growth (root rot, stem rot, wilt, blight, leaf spot, mosaic). Generally, only a small percentage of seed is infected but these can become centres of infection and contaminate the entire planting. It is important to know how organisms are associated with seed.

It is advisable for nurseries to find a source of seed certified for low levels of pathogens, as seed production may be difficult. A distinction can be made between seed borne pathogens present internally and externally.

- » Seed pathogens present externally
 - ◇ Pathogen propagules may be present directly on the seed surface. This usually occurs when seed are extracted from infected fruit, pods or capsules.
 - ◇ Seed may be contaminated with plant debris or soil that is infested with one or more pathogens. Plant debris may be from flower, leaf or fruit tissue and involve fungi such as *Colletotrichum*, *Alternaria* and *Ascochyta*. Contamination of seed with soil can occur during collection and processing. Common soilborne organisms that may be present include *Phytophthora*, *Pythium*, *Rhizoctonia*, *Fusarium* and *Macrophomina*.
- » Seed pathogens present internally
 - ◇ Fungal, bacterial and viral pathogens can be present in the internal tissue of seed. This can result from systemic invasion of the vascular tissue. Examples of vascular invasion include various vascular wilt fungi, black rot of crucifers caused by the bacterium *Xanthomonas campestris* and certain viruses, e.g. *Lettuce mosaic virus*. There can also be direct penetration through the ovary wall (e.g. *Botrytis*, *Cladosporium*), or invasion can follow the pollen pathway (e.g. *Cucumber mosaic virus*, smut and ergot fungi).

Pathogens may need to be eliminated from seed by chemical or hot water treatment. Well-tested and verified chemical seed treatments are effective for reducing or even eliminating seed pathogens present externally. Seed pathogens present internally require hot water treatment to be disinfested. Holding seed in hot water for a precise time, at a carefully regulated temperature will kill many fungal, bacterial and viral pathogens and may not adversely affect germination. It is best to use fresh seed rather than old seed for heat treatment. In general, small and robust seeds are best suited to heat treatment; large and delicate seeds may be negatively impacted. The exact temperature and time for the hot water treatment varies with the plant species and needs to be precise. Problems that can arise from hot water treatment include delayed or reduced seed germination or weak and deformed seedlings. For many vegetable lines, research has been completed to optimise seed treatment and are available online (refer to additional resources below).

IRRIGATION — WATER TREATMENT AND MANAGEMENT

Irrigation water can be a major source of contamination in nurseries. Irrigation water should come from a clean reticulated water supply or from deep wells or bores. Wells must be free of surface run-off water. Recirculated water and water from rivers, canals and dams must be disinfested using an approved method to manage *Phytophthora* and other water borne diseases. Not all disinfestation systems are suited to all nurseries, therefore [research and compare various systems](#) carefully prior to purchase and installation.

Choosing the correct watering regime for the nursery is critical. Overwatering will cause germinating seed and young seedlings to rot, even in the absence of plant pathogens. Any lichens, algae or water pooling on the surface of trays indicates that the trays are too wet. Also standing water in trays or on the nursery floor can lead to splash dispersal of pathogens.

Managing irrigation practices is also very important in reducing losses caused by many pathogens and for maintaining healthy root systems. Waterlogging causes anaerobic conditions that result in root damage. Damaged roots are more susceptible to a range of pathogens, particularly *Phytophthora* and *Pythium*, which are attracted to damaged roots. Furthermore, root damage affects subsequent root development and regeneration, which can influence overall plant health and nutrient status.

GROWING MEDIA

All components of the growing media should be considered as a source of contamination, though some have greater inherent risk than others. A growing medium with good drainage should be selected, and disinfested with steam (100°C for 30 minutes), or pasteurised with aerated steam (60°C for 30 minutes, steam then turned off and air continues to blow to cool the media to assist beneficial organisms present in the mix). These treatments will protect plants from soilborne pathogens. Note, sterilising media will also eliminate beneficial organisms. Soilborne pathogens added to completely sterile soil and media (e.g. in infested nursery stock or irrigation water) tend to spread rapidly. Therefore, incorporating commercial beneficial organisms (e.g. *Trichoderma* and *Bacillus*) may have value in creating a healthy growing environment, free of pathogens.

Media should be stored on concrete in an area free of contamination by infested soil, water or plant material (including weed seed). Coir bricks and other packaged media should be stored dry until use. Use clean equipment when loading treated growing media. Equipment contaminated with soil and plant material may introduce pathogens. For more information refer to the [nursery paper on media storage](#).

Not all growing media is ideally suited to produce all plants and it is recommended to monitor pH and EC on a regular basis. Do not assume that pH, EC and other media parameters (e.g. air-filled porosity) remain constant. Complete in-field trials using different media or ratios of media to grow a variety of plant lines to test what medium is best for each line. Alternatively, choose plants that can be grown well with your chosen media. For more information refer to the nursery paper on [growing media parameters](#).

MAINTAIN GOOD HYGIENE PRACTICES

Clean, clutter-free growing areas and walkways are essential and assist in preventing a contamination hazard. Healthy stock can be put at risk of pathogen infection when they are placed in growing areas that have weeds, algal growth, other organic matter or old stock. The following hygiene practices are recommended to prevent pathogens infecting nursery stock.



Keep growing areas clean and disinfest between plantings.

- » Remove infective material hygienically. Avoid contact with healthy plants when removing infected material as this can spread the disease. In most cases, deep burial is sufficient, and may be completed on site or through council waste services. It is not recommended to discard plants suspected or knowingly infected with plant pathogens in a heaped pile on site. Disinfest tools and equipment that come in contact with infected plants.
- » Remove weeds under benches, around the growing area, in nursery stock and in close proximity to the nursery. Weeds may harbour pests and pathogens that can move into the nursery, even if they appear healthy.
- » Only use new or heat-disinfested containers. Chlorine disinfestation can lead to failure if *any* infested organic matter is left in the pot; chlorine treated roots infected with pathogens remain viable and may reinfect subsequent plants placed into containers. The time required for cleaning old containers often makes chlorine disinfestation prohibitive.
- » Discard all containers from plants that were infected with root and vascular wilt pathogens.
- » After removal of plants from the propagation area, remove all leaf debris and potting media from benches and treat with an appropriate disinfectant. It is important that drip irrigation and mini-sprinklers mounted near the surface of the growing media be disinfested prior to new plants being placed on a bench.
- » Encourage nursery staff to wash their hands regularly, and actively participate in maintaining the cleanliness and sanitation of the nursery. Train nursery staff to be early detectors of insects and unhealthy plants.
- » Control movement of staff and visitors. Install foot baths between different production areas to disinfest shoes, particularly where plants are grown at ground level.

CONCLUSION

No single action can prevent pathogens from entering propagation and other nursery production areas. Put in place as many risk mitigating factors as possible. Ensure that all inputs are free of pathogens, including propagative material, irrigation water and growing media. Keep growing areas clean and maintain rigorous hygiene practices. Monitor crop health regularly and take management actions early; submit samples to a diagnostic laboratory to confirm the causal agent. These actions will increase your ability to propagate healthy plants, free of pathogens and pests.

ADDITIONAL RESOURCES

- » [Soil borne diseases management plan](#)
- » [Preventing diseases webinar](#)
- » [Disinfesting growing areas](#)
- » [Growing media nursery paper](#)
- » [University of Massachusetts hot water seed treatment factsheet](#)
- » [University of Wisconsin hot water seed treatment factsheet](#)
- » [LSU AgCenter hot water and chemical seed treatment factsheet](#)

This document was prepared by Ken Pegg and Andrew Manners (Agri-science Queensland, Department of Agriculture and Fisheries, Ecosciences Precinct, GPO Box 267, Brisbane QLD 4001) as part of the nursery levy and Hort Innovation funded project Building the resilience and on-farm biosecurity capacity of the Australian production nursery industry (NY15002) in 2020. All photos by DAF.