



Propagation and Planting of Kauri

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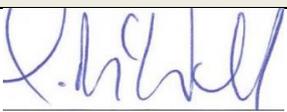
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Approval

Name	Role	Signature/ Date	Endorsement
Patricia McNeill Programme Manager	Approve / Note the contents of this document		<input checked="" type="radio"/> Yes / No

Associated documents

Document name	Link
Hygiene Procedures for Kauri Dieback	https://www.kauridieback.co.nz/how-to-guides/
Land disturbance activities (incl. earthworks) around kauri	
Tree Removal and Pruning of Kauri	
Landfill disposal of contaminated material	
Vehicles and Heavy Machinery	
Disease symptomology	https://www.kauridieback.co.nz/recognising-symptoms/
Kauri Care	https://www.kauridieback.co.nz/media/1852/2018-kd-care-guide-booklet-a5.pdf

Glossary

Terminology	Meaning
Janola	5% solution of detergent Janola®
Kauri dieback	Name of the disease that causes dieback on kauri caused by the pathogen <i>Phytophthora agathidicida</i>
KDP	Kauri Dieback Programme
Outermost dripline	The furthest (maximum) extend of the branch spread from the trunk.
PA	<i>Phytophthora agathidicida</i>
Propagule	Microscopic life stage (like seeds) whose role is to progress the propagation of an organism to the next stage in their life cycle.
Sterigene	2% solution of detergent Sterigene
Virkon	1% solution of detergent Virkon® S
Wash-down	Removal of soil and organic material using pressurised water and brushes.
Wastewater	Water generated from irrigation and wash-down operations.

Disclaimer

The information in this guideline is intended to be general information. It is not intended to take the place of, or to represent, the written law of New Zealand or other official guidelines or requirements. While every effort has been made to ensure the information in this document is accurate, the Kauri Dieback Programme (and any of their representatives involved in the drafting of these guidelines) does not accept any responsibility or liability for error of fact, omission, interpretation or opinion that may be present nor for the consequences of any decisions based on this information.

1.0 Purpose

To provide guidelines to minimise the likelihood of spread of kauri dieback (*Phytophthora agathidicida*) during the propagation and planting of Kauri (*Agathis australis*).

2.0 Background

Kauri dieback is a soil-borne disease that spreads primarily through the movement of contaminated soil. However the disease can also spread through the propagation, movement and the planting of infected seedlings.

The pathogen forms long lived spores (oospores) in roots of kauri and potentially other plants living in the present of kauri.

Nursery production and plant distribution is inherently associated with numerous biosecurity risks, including *Phytophthora* spp. Nurseries in other countries have contributed to the spread of *Phytophthora* pathogens because growing conditions at nurseries (e.g. high moisture and warm temperatures) favour pathogen growth.

Additionally results of kauri dieback surveillance to date suggest that some of the current PA distribution in New Zealand may be due to historic movement of kauri seedlings and one nursery has already been found to be infected with PA.

Due the potential high risk of PA being vectored by soil and plant movement, a set of guidelines has been developed to provide best practice and precautionary advice to assist nurseries, commercial growers and community groups wishing to undertake propagation and planting of kauri.

3.0 Assumptions & Constraints

It is recognised that the effectiveness of these guidelines may be constrained by a number of factors so the following assumptions have been made which has informed these guidelines.

- 3.1 The soil and waterborne propagules of PA remain viable and infectious for unknown period of time. However long-lived spores (oospores) of kauri dieback can survive and remain viable in the soil, long after a tree dies (at least 6 years and potentially a lot longer)(Horner, 2015).
- 3.2 Human activities such as planting which involve the active and passive movement of soil, water, and infected plant tissue/materials contaminated with PA propagules and inoculum will spread PA.

- 3.3 Endophytic seed transmission of PA is unlikely due to low biosecurity risk during the propagation of kauri from seed.
- 3.4 The level of virulence and latency of PA on each individual kauri is unknown. Therefore it is possible a kauri plant may be infected by PA but not express any visible symptoms, or express symptoms long after infection.
- 3.5 PA propagules could be present in soil/planting medium (e.g. potting mixes) but has not yet infected susceptible plants in the same soil/planting medium.
- 3.6 The complete host range of PA has not been defined, therefore PA may be spread through the propagation and planting of other plant species.
- 3.7 PA do contain waterborne propagules i.e. zoospores which spread in soil water, however spread from open water sources has yet to be proven (Randell *et.al*, 2010). There is anecdotal evidence that spread via wastewater run-off and water catchment discharge is possible, however standardised methods for the detection of waterborne propagules of PA in waterways are currently unavailable.
- 3.8 Methods to disinfect water is unknown at this stage. The use of Chlorine has been used to disinfect irrigation water reservoirs to suppress *Phytophthora*, however the Chlorine concentration to treat PA as well as having minimal impacts on kauri seedlings is not known. The installation of five micron filters is an alternative treatment as this filter size will screen out most plant pathogens including PA, however the degree of efficacy may depend on particle size distribution, the ratio of surface area and the flow rate of water (Manning, 2007). PA oospore average size is 28 microns whereas zoospores are a lot smaller, on average 5 microns (Weir *et. al.*, 2015).

4.0 Before you begin

- 4.1 These guidelines has been developed to provide written advice on the management of kauri dieback to reduce the likelihood of kauri being infected with kauri dieback during the propagation and planting of kauri.
- 4.2 The guidelines are not policy but should be considered by planners, land managers and contractors when planning any operations.
- 4.3 Please contact your Regional council or land management agency to confirm any local policy requirements or regulatory constraints. In particular whether the area you wish to plant is currently under a Controlled Area Notice.
- 4.4 The guide provides what is considered best practice based on the current information and uses risk management principles to reduce the likelihood of spread of PA during operations.

5.0 Planning Considerations

- 5.1 Prior to planting, a Biosecurity site management plan is advised before undergoing planting operations. Refer to Section 6.4.2
- 5.2 The following Best Practice Guidelines should be read in conjunction with these guidelines, prior to undertaking any on-site operations.

Table 1: Associated Readings

Guidelines	Link
Hygiene Procedures	https://www.kauridieback.co.nz/how-to-guides/
Land disturbance activities (incl. earthworks) around kauri	
Tree Removal and Pruning of Kauri	
Landfill disposal of contaminated material	
Vehicles and heavy machinery	
Kauri care guide	https://www.kauridieback.co.nz/media/1852/2018-kd-care-guide-booklet-a5.pdf
Kauri dieback symptomology guide	https://www.kauridieback.co.nz/recognising-symptoms/

6.0 Management Measures

Managing the pathways of possible introduction of the pathogen during seed collection, propagation and planting is critical.

There are four stages that need careful consideration in order to produce healthy disease free kauri seedlings and to minimise potential contamination during propagation and planting of kauri. Between and during each stage, footwear, clothing, equipment and vehicles should be cleaned and disinfected or changed where advised.

6.1 Seed collection

- All planted kauri should be eco-sourced from trees as close to the proposed planting area as possible and from bush/plantings that are not known to have PA.
- Eco-sourcing is particularly important for large kauri re-vegetation projects and planting projects contiguous with natural kauri forest.
- Eco-sourcing, while still preferable, is less critical for individual trees or small stands planted for limited ornamental amenity use e.g. in urban gardens/parks.
- Depending on area of land tenure, seed collection permits may be required prior to collection. They will be required for collection from DOC or Council administered lands.
- Cones containing seeds should be collected from a healthy tree with good foliage cover and no signs of yellowing leaves or any trunk lesions in the lower trunk area.
- Cones containing seeds should not be collected from symptomatic trees or from trees where PA infection has been confirmed.
- Cones containing seeds should be collected from at least 1 m above the ground to be sure it has not had contact with contaminated soil or leaf litter.

Further information for germinating and growing kauri from seed can be obtained by referring to the Kauri care guide (Table 1).

6.2 Propagation

6.2.1 Growing media

- It is essential that the mix is pathogen-free, free draining but still has a good moisture holding capacity. Perlite, vermiculite and commercially composted mulches, are often free of the most common pathogens.
- Propagation of plants in containers with commercial supplied potting mix is advised.
- Storage areas for the growing media must be raised above the level of the surrounding land by 10-12 cm to prevent all runoff water from entering the area. The area below the growing media must drain freely and away from the media.
- For bulk media, store in sterilised, covered bins on a hard dry surface constructed to prevent all runoff water from entering the area.
- Different batches of media should be stored separately to avoid cross contamination.
- All storage surfaces must be suitable for easy cleaning and disinfestation between batches.
- Recycled or used media is not advised.

6.2.2 *Water*

- Municipal reticulated, bore, spring or rain water does not usually require treatment.
- Water sourced from dams, creeks or bores would need to be treated before use in the nursery. The use of chlorine has been used to disinfect contaminated water for *Phytophthora* spp. in the past however its use on PA has not been tested. The use of a 5 micron filter is advised as an alternative.
- Ensure the nursery site is well drained. Water used for irrigation should drain free from the plant propagation area and be collected and treated, or diverted in such a way that prevents surface water accumulation.
- Avoid overwatering.
- Do not recycle water.

6.2.3 *Plant storage & containers*

- New pots and containers should be used where possible otherwise clean and disinfect used containers before re-use.
- Do not grow containerised plants on bare ground. Growing areas should be raised off the ground to prevent contamination with soil and water overland flow.
- Benches with an elevated mesh top are ideal instead of wooden surfaces. Benches should be cleaned and disinfected during periods between batches.
- Kauri seedlings batches should be kept separate and in a separate location from other plants.

6.2.4 *Equipment & Hygiene*

- Contamination sources such as dirty equipment, tools, containers and preparation surfaces often pose the greatest risk of plant disease. These items should be cleaned and disinfected regularly and thoroughly to eliminate disease risk.
- Wash equipment, tools and pots well away from the propagation and nursery area.
- Items can be disinfected using recognised disinfectants such as Virkon[®] S, Janola[®], and Sterigene.
- Disinfection can be carried out AFTER all soil and contaminants have been washed off and can be either applied as a surface wipe, dip or spray.
- All tools must be cleaned and sanitised between batches of media or different plant lots.
- Sanitise planting containers being recycled by washing containers free of any contaminants and then disinfect and then rinse off using clean water.
- Restrict entry of people to propagating areas. Personnel footwear will need to be cleaned of any soil and contaminants before entering the propagation area. The use of footbaths is advised. The use of disposable plastic shoes is an alternative before entering.
- Vehicles, equipment will need to be cleaned of any soil and contaminants before entering the propagation area. The water from the wash-down should be diverted away from the site.
- Do not use fungicides, biological control products or phosphite in any of the propagation steps. These products may conceal the presence of PA making it difficult to detect.
- Concrete or bitumen floors are advised, an alternative is 5 cm of clean gravel.

6.2.5 *Diseased plants and waste material*

- Any plants that appear unhealthy should be removed immediately (including the soil surrounding the plant) as waste material.
- Discarded plants, pruning's and spilt media should be collected regularly and contained in a dedicated collection area well away from the propagation and growing area.
- Recycling or composting growing media and plant materials and reusing used water is not advised.
- Ensure correct disposal of propagation waste materials.
- Refer to guidelines for landfill disposal of contaminated material for further information (Table 1).

6.3 **Holding and monitoring period**

- A holding period of at least 3 months from potting prior to planting is advised.
- Kauri plant batch lots should be kept separate. Keep all kauri away from propagation areas and other plants during this time.
- All plants should be checked prior to handling, movement or planting. Unhealthy plants and plants from lots where there is any rapid unexplained death should not be moved, sold or planted.
- Unhealthy plants should be disposed of as waste material or held for testing. If held for testing, then they should be contained and separated from healthy plants.
- If testing is not to be conducted, unhealthy plants should not be composted or sent as green waste. Plant waste should be double bagged and sent to landfill or burnt on site.
- Diagnostic sampling is advised if symptomatic kauri are observed. Refer to Table 1 for symptomology guide.

If you have any concerns about the health of your plants or your plants are showing dieback-like symptoms then please contact 0800 NZ Kauri (69 52874) or email kauridieback@mpi.govt.nz

6.4 **Planting out**

6.4.1 *Site assessment*

Prior to planting, a site assessment should be undertaken to ensure the site is suitable and to consider the potential risks **before** any specific biosecurity site management plan is developed. A site assessment could include the following:

- A risk assessment to determine whether the area has kauri dieback or not.
- Contact your Regional Council or DOC to determine if they have any records of kauri dieback being detected in the area.
- A tree health assessment of any existing kauri in close proximity to the planting site (using the symptomatic guide listed in Table 1) could be carried out.
- Identify vector pathways to determine the likelihood of kauri dieback spreading to the area being planted e.g. livestock, pigs and human vectoring.

6.4.2 Site management

From the initial assessment, a biosecurity site management plan can be developed, to manage any risks to ensure long term longevity of kauri being planted. A plan may include actions such as:

- If livestock, pigs and possums present, consider fencing off planted areas.
- Planting kauri in close proximity to visitor access points (e.g. walking tracks) is not recommended.
- A hygiene management plan taking into consideration advice provided in the associated readings in Table 1, in particular hygiene guidelines when working around kauri and the use of vehicles and heavy equipment.
- A planting plan, locating the area where planting is to occur considering the results of the risk assessment.
 - Planting kauri in close proximity to existing kauri forest and seed sources is not advised.
 - At a minimum, kauri should not be planted within 3 times the dripline of existing kauri (Figure 1).
 - A protection buffer zone of at least 30 meters between planted kauri is recommended where possible.

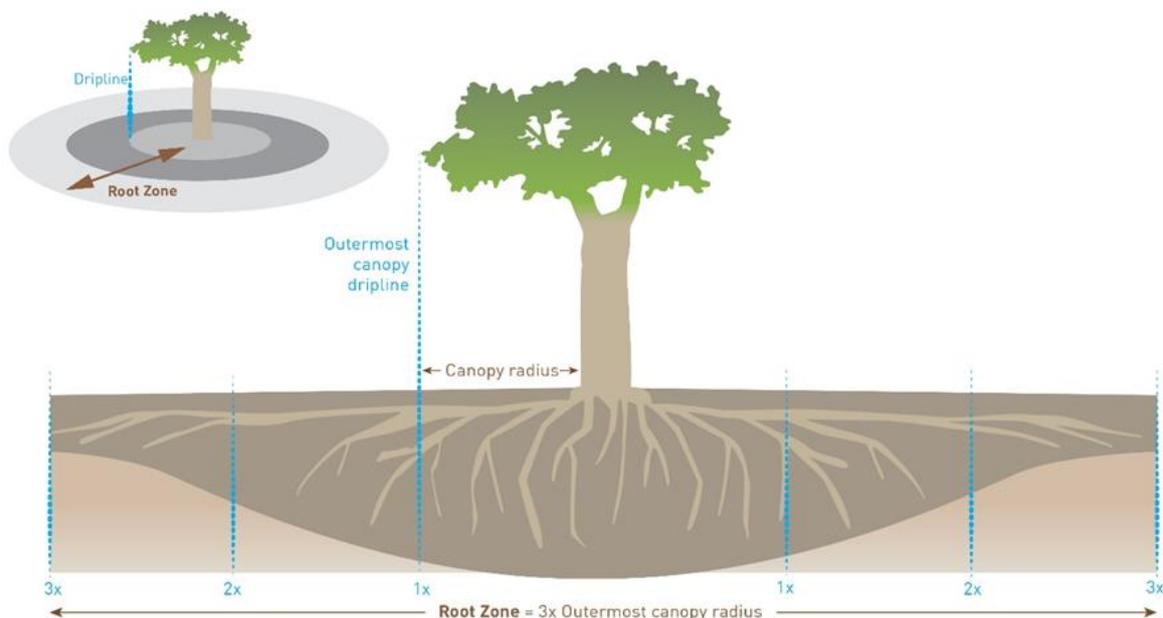


Figure 1: Root zone of kauri (3 times the radius of the outermost canopy dripline).

6.4.3 Other considerations

- Undertake planting in dry weather wherever possible to reduce contamination on footwear and equipment and to make decontamination operations easier. If necessary

postpone planting operations and reschedule when there are drier conditions. Contaminated wet soil tends to cling to footwear and equipment making it easier for PA to be transported.

- Sites should be monitored for establishment success of plants. Further information for site preparation and maintaining plants, refer to our Kauri Care Guide.

7. Training, auditing and accreditation

- All staff, contractors, volunteers, community coordinators should be trained and made aware of the kauri dieback hygiene procedures
 - Regular auditing and monitoring should be undertaken to assess ongoing compliance and awareness.
 - NZPPI is developing biosecurity best practice scheme (PPBS) that includes measures to protect kauri propagation from PA and other Phytophthora diseases of kauri. Nurseries and growers will soon be able to gain certification in biosecurity best practice.
 - In the meantime, the draft NZPPI PPBS scheme is available at www.nzppi.co.nz/ppbs. Use the Core Standard, the Entry Checklist and the Core Standard Hazard Management Checklist to assess and improve your biosecurity management.
 - Seek assurances from all nursery suppliers have adopted the NZPPI PPBS protocols.
 - NZPPI also provides an industry training module “Nursery Production Farm Management System” (FMS) that guides continuous improvement, change and technology adoption on-nursery. Detailed information about the Nursery Production Farm Management System and how to participate is provided at: <https://nzppi.co.nz/capacity/108-233/nursery-production-farm-management-system-fms>
 - The kauri dieback management programme supports the biosecurity guidance and training provided by the NZPPI PPBS and FMS programmes and advises nurseries undertaking large or regular kauri and other native plant propagation to participate.
 - Sourcing kauri plants from suppliers and nurseries participating in the PPBS and FMS is advised.
 - Additional advice can be sought directly from New Zealand Plant Producers Incorporated (NZPPI). Phone 04 918 3511 or email office@nzppi.co.nz or visit the webpage www.nzppi.co.nz
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