

# PROJECT SUMMARY



RURAL  
INDUSTRIES

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Corporation

## Tea tree – causes and management options for stump death or dieback

The Australian tea tree (*Melaleuca alternifolia*) oil industry is one of many new and emerging rural industries bringing opportunity, diversity and resilience to rural Australia. Originally a 1980s cottage industry, it now produces over 700 metric tonnes of pure Australian tea tree oil per annum with an estimated farm-gate value of \$28 million in 2014, 85 to 90 per cent of which is exported to more than 20 countries worldwide.

Integrating pest and disease management into a whole-of-farm model where plant health is at the forefront is vital to ensure continued growth and expansion of the industry without dramatically increasing the use of pesticides and the risk of developing resistance to these.

This fact sheet summarises findings from RIRDC project *Integrated pest & disease management in the tea tree oil industry* to do with efficacy and residue data for a topical fungicide and foliar and ground-applied insecticides.

For more information on this research contact RIRDC ([www.rirdc.gov.au](http://www.rirdc.gov.au)) or the Australian Tea Tree Industry Association ([www.attia.org.au](http://www.attia.org.au)).

### What is tea tree dieback or stump death?

Management of tea tree (*Melaleuca alternifolia*) grown in monoculture plantations includes cutting plants back to ground level at harvest leaving a stump. Generally plants then reshoot and grow, with the following harvest occurring in 12 to 14 months. In recent years, growers have faced a new challenge in the form of dieback or stump death. Soon after harvest, young leaves and shoots begin to yellow and in many cases the tree dies. This threat is of particular concern in far north Queensland (FNQ) growing areas.

### Recent research into cause(s)

Researchers from the University of the Sunshine Coast (USC) led by Dr Fiona Giblin have carried out investigations to identify the causal agent(s) of tea tree dieback.

Researchers collected root and soil samples from the rhizosphere zones of trees on the Atherton Tableland area of FNQ. The sampled trees ranged from symptomless to showing severe dieback. Nematodes were not present. Many of the roots were blackened and in many cases there were very few feeder roots. Pure fungal cultures obtained from the samples were then used to inoculate healthy seedlings. Seedling health was monitored over time and after 10 weeks the seedlings were assessed for overall health and disease incidence and severity.



Tea tree plant dieback

Their work isolated and identified the fungus *Macrophomina phaseolina* from the root zones of tea tree plants suffering symptoms of dieback. This fungus causes charcoal rot in a range of crops and has greatest impact when a plant is subjected to stress, both biotic (pathogens, insects) and abiotic (drought, high temperatures). In other crops where *M. phaseolina* is a problem, plants growing in good conditions are unlikely to be seriously affected.

While it has been determined that this fungus can cause disease in the glasshouse (fulfilling Koch's postulates), it is uncertain if it is the primary cause of disease or if it is part of a disease complex including multiple soil-borne pathogens.



## MAJOR COMPONENTS OF INTEGRATED MANAGEMENT OF SOIL-BORNE PATHOGENS

In 2014, Dr Giblin and colleagues reviewed cultural and nursery practices for management of soil-borne pathogens, including those causing dieback or stump death in tea tree. They collected practical advice on how to integrate components for controlling soil-borne disease and identified a number of different management approaches, several of which are sensible agronomic and/or horticultural practices.

### Soil selection

Key factors influencing disease development include:

- soil temperature
- soil pH
- soil aeration
- soil moisture
- soil salinity
- soil nutrient status.

### Exclusion and orchard hygiene

In many areas pathogens such as *Macrophomina phaseolina* may not be endemic and the simplest management approach is to prevent its introduction. If it is introduced, good crop hygiene will help prevent its spread. Pathogens can spread via contaminated water, infested soil (usually containing small pieces of infected plant tissue) and by nursery plants. The pathogens may be present in the field long before symptoms appear.

### Biological control: mulches, composts, manures, suppressive soils

The benefits of mulches to suppress soil pathogens are well known. Most tree crops respond positively to under-tree mulching and compost/manure application. However, it can be a costly operation. Care needs to be taken when transferring technology developed for a subtropical evergreen tree to a native tree such as tea tree. There may be beneficial responses, but growers will need to consider the cost/benefit relationship. This may involve choosing an appropriate and readily available material (such as tea tree mulch), and determining the time of application to suit local growing conditions.

The most suitable mulch material is still debatable; choice will depend on the availability and expense of local materials. A mulch with a C:N ratio of 25:1 to 100:1 is recommended to avoid a serious nitrogen draw-down (e.g. hardwood or softwood sawdusts have a C:N

ratio of 400–500:1). Suitable mulches include composted pine or hardwood bark, aged hardwood chips and high-fibre straws (wheat, barley). Natural leaf fall is also effective but not as effective as woody mulches. The mulch should not be too moisture retentive and must not be allowed to accumulate around the base of the trunk as it will encourage crown infection and canker development.

Mulching will alter irrigation and nutritional requirements of the tree.

In forests, soil pathogens are known to be present but do not cause disease under conditions suitable for disease development. Disease-suppressive soils may be replicated by continually adding large amounts of plant residues from cover-cropping and mulching with straws, as well as chicken manure and calcium to improve soil health and stimulate the activity of indigenous suppressive microbes. If extensive applications of mulches are not made to soils serious outbreaks of root pathogens will occur.

A key difference between healthy and sick orchards is in soil organic matter content and the biological activity of disease-conducive and/or disease-suppressive topsoils.

Chicken manure may be tested as a pre-plant treatment. Planting sites are filled with chicken manure (as fresh as possible) which releases ammonia and organic acids which might be toxic to pathogens (true for *Phytophthora cinnamomi*) but unfortunately also to plant roots. It is best incorporated months prior to planting to allow toxic levels of ammonia and chlorides to fall. The treatment also increases total biological activity and populations of antagonistic actinomycetes, pseudomonads, fungi and bacteria.

There is a lot of interest in using organic amendments in tree orchards. These include applying products such as 'compost tea', humic acid and other biologically enriched mixtures as organic fertilisers and root growth promoters. It should be stressed that the addition of organic matter alone (without fungicide) will probably be insufficient to control pathogens where there is high disease pressure.



A young tea tree plant suffering from dieback



A healthy young tea tree plant

There is also interest in using antagonistic organisms such as *Trichoderma*, *Gliocladium*, *Bacillus*, *Pseudomonas* and *Streptomyces* to suppress disease in nurseries where there is a well-drained and aerated potting mix, and favourable temperatures and moisture levels for root growth.

They are less effective in the field where soil and weather conditions are often quite unsuitable. FNQ has unique soils

and is (usually) only irrigated; this level of control may allow the use of *Trichoderma* or other antagonistic fungi. Biological control is generally more effective using mulches, composts and manures that stimulate resident antagonists rather than simply adding beneficial microorganisms to poor soils.

### Cultural control

Good soil drainage is usually essential to maintain balance in soils, although tea tree has a much higher tolerance to waterlogged soils. Also, charcoal rot actually prefers dry, hot conditions. Nonetheless, a well-designed irrigation system should be set up so that excessive water does not exacerbate the ongoing effects of root and trunk rot. For instance, in light of the environmental preference of charcoal rot (i.e. hot, dry conditions)

irrigation practices could be modified to maintain a moist soil profile before harvest and to immediately recommence irrigation post-harvest to reduce stress in the harvested plants.

An addition of calcium (usually gypsum, unless pH correction is required) can be effective as it acts as a mild fungicide, although this would need to be assessed.

### Chemical control

Little work has been done on the use of chemicals for soil diseases in the tea tree industry and control of charcoal rot in other crops has proven difficult. Timing of fungicide applications in relation to growth events is important and would need to be ascertained through field trials.

### Pathogen-free nursery plants

Pathogen-free nurseries are key to the establishment of healthy orchards. Soil pathogens are primarily dispersed in infested soil, water or infected planting material. Pathogens can be especially detrimental to nursery plants, as they will thrive in the nursery environment. Free water, high levels of humidity, favourable temperatures, and susceptible plant tissue (young, rapidly growing roots) are always available for infection. Most nursery crops are monocultures with limited genetic diversity and they are extremely vulnerable to disease epidemics.

All industries can consider having an accreditation scheme for their nursery stock. Accreditation is usually a voluntary process administered by industry where no one is obliged to join. Such an accreditation scheme has been operated by the avocado industry (Avocado Nursery Voluntary Accreditation Scheme or ANVAS) to protect against *Phytophthora cinnamomi* since 1979.



Nursery trees should be propagated under best-practice guidelines such as those outlined in the Nursery Industry Accreditation Scheme Australia (NIASA). It may be possible to partner with NIASA and form a national tea tree industry (self-regulated) nursery accreditation scheme for the development, continued improvement, and observance of guidelines for the production of pathogen-tested true-to-type tea tree nursery trees. Soil-borne diseases need to be managed successfully in nurseries to provide pathogen-free planting material and reduce the risk of spreading pathogens such as *Macrophomina* spp. to all production areas.

The fundamental principle for disease control in nurseries is that it is better to avoid disease than have to apply controls after a disease outbreak. Excluding soil-borne pathogens from production nurseries can be difficult at times, but where it is possible it is the most cost-effective disease management strategy. It is perhaps easier for the production of container grown plants, but it is achievable for in-ground production. It may involve more intensive sampling for soil-borne pathogens. Infested sites may require fumigation with an approved fumigant. Long-term success will then depend on effective quarantine of the site after treatment. The area will need to be well drained and perhaps include a raised-bed system. All water from adjacent areas will need to be deflected from the site. The area needs to be fenced to prevent access to animals and vehicles. Access to the site should be limited to essential staff, and they will need to walk through footbaths which are regularly cleaned and replenished. Before starting work they should wash their hands with soap and water or an approved hand-washing biocide. Good hygiene will be required

in the nursery especially the use of irrigation water that is free of soil-borne pathogens. Surface water supplies are nearly always contaminated and must be disinfested.

Fungicides to control soil-borne diseases in a nursery should only be used to limit spread of a disease outbreak. They can also be used to protect healthy plants at vulnerable times (e.g. when roots are damaged during repotting). They rarely eradicate a pathogen or eliminate disease, and should not be used to compensate for poor nursery hygiene. They generally only mask symptoms of a disease, the pathogen will still be present, and this will lead to serious problems when trees are planted on the farm.

### Resistance

Host resistance is the best method of reducing root and trunk rot. Resistance may not be absolute, particularly where disease pressure is high, and resistance must be combined with traditional methods of management. With many plant pathogens, resistance is often a form of tolerance. Some rootstocks produce new feeder roots more quickly than susceptible rootstocks in the presence of the pathogen.

Resistant or tolerant rootstocks, where available, are a vital component of an integrated management program. It is often quite difficult to find high resistance to soil pathogens which have a large host range. Resistance may not be adequate to cope with severe disease pressure.

For all industries, there is a need to develop robust tests for disease-resistance evaluation of local selections.

This report is an addition to RIRDC's diverse range of over 2000 research publications and it forms part of our Tea Tree Oil R&D program which aims to support the continued development of a profitable, productive and environmentally sustainable Australian tea tree oil industry that has established international leadership in marketing, value adding, product reliability and production. This project achieves this by fostering communication that increases understanding and thereby encourages greater use of tea tree oil.

Most of RIRDC's publications are available for viewing, free downloading or purchasing online at [www.rirdc.gov.au](http://www.rirdc.gov.au). Purchases can also be made by phoning 1300 634 313.



### More information

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