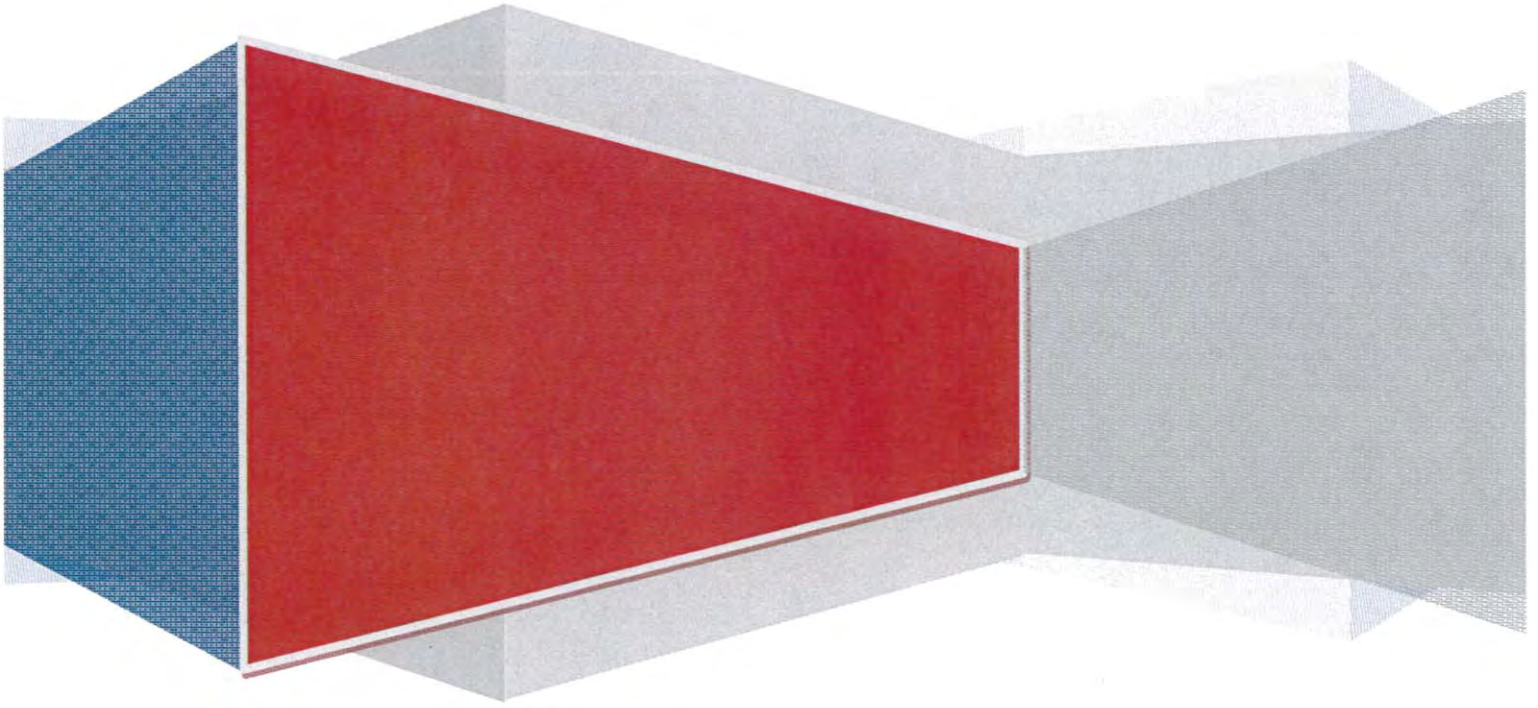
Plan for Transition to Management of Myrtle Rust

Version 1 - November 2011



Plan for Transition to Management of Myrtle Rust

1. Overview

The rust caused by *Uredo rangelii*, which is known as Myrtle rust, was detected in Australia on 23 April 2010 on a cut flower growing property on the central coast of New South Wales. The rust was confirmed on *Agonis flexuosa* (willow myrtle), *Syncarpia glomulifera* (turpentine) and *Callistemon* (bottlebrush) growing on and near the property.

On 30 April 2010, the National Management Group (NMG) agreed that it was not technically feasible to eradicate Myrtle rust from Australia, based on considerations that:

- The rust was present for four weeks or more before it was reported to authorities and any fungicide treatment was applied to restrict sporulation and fungus spread;
- Spores from infected plants had been spread during that period by wind and through bee movements from the heavily infected *Agonis* block onto another *Agonis* block on the property and possibly to roadside *Syncarpia* plantings nearby;
- Cut foliage that is known to be infected had been sent to the Sydney Flower Market and to subsequent sale for at least a month before the disease was treated with fungicide;
- The efficacy of tools to effect eradication, including fungicides and host destruction in the infected area, is limited; and
- There are large areas of contiguous native vegetation adjacent to the known infected properties (there were several subsequently identified) and these forests include *Syncarpia*.

On 2 July 2010, the NMG agreed to implement an Interim Response Plan (IRP) aimed at collating more information and knowledge of the disease, and the incursion, and to investigate whether containment and suppression might lead to possible eradication of the fungus. The IRP included the following:

- removal of host material at IP1;
- establishment and fungicide treatment of a buffer zone around IP1;
- application of fungicide to continue the suppression of the disease;
- spore trapping to establish whether the rust was spreading;
- general surveillance;
- host range testing; and
- studies to distinguish the genetic differences between Myrtle rust and Guava rust.

With the detection of Myrtle rust in several nature reserves and some State Forests in the Central Coast and subsequently in Queensland through December 2010, the NMG confirmed on 23 December 2010 that eradication of the pathogen was not technically feasible, despite efforts under the IRP to suppress the disease.

However, NMG also agreed there was a need for ongoing arrangements for the management of the pathogen due to the potential for further impact on the natural environment, the community and affected industries. NMG considered that these arrangements should focus on mitigating the impact of Myrtle rust on the natural environment, including threatened and endangered species, and industries that rely on

Myrtaceae and *Eucalyptus*; education and awareness raising strategies; and collation and analysis of the behaviour of the pathogen, and its impacts on natural ecosystems.

Accordingly, a National Myrtle Rust Coordination Group developed a thematic strategy to stimulate research and joint activities where appropriate. The Australian Government is now investing $1.5 million in 2011-13 within selected areas of this strategy to progress a transition from eradication of Myrtle rust to management of the disease as it becomes naturalised and establishes itself in various ecological niches across Australia. This investment will provide information and tools to enable industries and communities to mitigate the impacts of the disease in urban, primary production and natural environments. The proposed transition to management (T2M) program will be implemented as a series of research and development projects and will provide multi-jurisdictional benefits with both immediate outcomes and longer term benefits. Jurisdictions and research organisations may undertake complementary work that will augment the strategy.

The overall objective of the strategy is to generate information that may assist practical control options and to improve understanding of the environmental impact of the rust.

The intended key outcomes of the national strategy are:

- a set of national communication activities that will help stakeholders understand and adjust to the presence of the disease with a view to enabling them to implement long-term management strategies for the disease. This might including a web portal for information sharing between stakeholders;
- targeted surveillance in non-infected areas (e.g. by sentinel sites) to monitor long distance spread of the pathogen and to alert industry in newly infected areas to the potential need for rust control measures;
- collection of samples and gene sequencing of selected members of the Guava rust complex and related species, sourced from fungal collections around the world, and molecular analysis to determine the phylogenetic relationship between the Myrtle rust in Australia and other members of the Guava rust complex;
- full gene sequencing of the full genome of Myrtle rust that will provide the basic information required for a new real-time polymerase chain reaction (PCR) diagnostic protocol for biosecurity purposes, to enable rapid identification of a range of Guava rust species;
- screening for Myrtle rust susceptibility of key environmental and commercial host species, including transition to field observations, in combination with mass screening for identification of resistant genotypes;
- to foster research to determine the ecological and landscape impact of myrtle rust in native and commercial environments;
- the development of data for registration of chemicals for the control of Myrtle rust through consultation with the Australian Pesticides and Veterinary Medicines Authority (APVMA);
- better understanding of the genetic basis for host plant resistance;
- investigate the feasibility of establishing a national resistance screening facility that can assist commercial industries (essential oil, horticulture, forestry and nursery and garden) and conservation land managers to develop breeding programs for beneficial species.

The success of the strategy will be measured in the development of information and knowledge that is available to assist with the implementation of management options by researchers, affected industries, land managers and the general public.

2. The Pathogen

Currently Myrtle rust is understood to be a part of the guava rust complex that infects the Myrtaceae family of plants. The Myrtaceae encompasses many Australian native species. Myrtle rust produces lesions on young, actively growing leaves and shoots, as well as on fruits and sepals on some species. Leaves may become buckled or twisted as a result of infection. On turpentine and callistemon, rust lesions are purple in colour, with masses of bright yellow or orange-yellow spores.

Rusts are highly transportable. Their spores can be spread on contaminated clothing, infected plant material, equipment and hand tools, by insects, and by wind dispersal. Fungi in the guava rust complex affect commercial plant growing operations and native ecosystems. They typically attack young plants and new growth on established plants.

The pathogen has a very wide host range that may cause differential impacts in plant communities that could lead to ecological changes in forests and native ecosystems.

A range of tactics has been used to manage the Myrtle rust outbreaks in commercial operations in Australia, including the use of fungicides and other disease management measures. Spread and establishment is dependent upon availability of susceptible host tissues and suitable environmental conditions.

A large amount of information has been collected on the disease since April 2010. Accumulated knowledge of the fungus and its behaviour under Australian conditions is increasing and has been assisted by an epidemiological review, but its biological range, including host range, and its definition in relation to Guava rust, *Puccinia psidii* are still to be resolved.

3. The future state – living with Myrtle rust

Many plant communities within the potential habitat range of Myrtle rust will become affected by its presence as it spreads. The final distribution of the rust in Australia is unknown but it is likely it will thrive in warm and humid coastal areas including the tropics and coastal semi-tropical areas, although it may also spread across temperate areas. Dryer and cooler inland areas may experience seasonal incursions or outbreaks of the disease but these are likely to either die out over winter or progress very slowly in cool weather, as has been observed in NSW. International experience indicates that fungi in the guava rust complex are highly adaptable and so the host range and environments in which the fungus survives may increase over time.

In garden situations the rust is likely to infect host plants either continuously or seasonally. It will produce leaf spots on susceptible host and under ideal conditions may kill shoots on

established plants of very susceptible species. Younger plants that are highly susceptible to the disease may be killed if heavy infection occurs. To control the rust, home gardeners will need to apply effective fungicides at regular intervals while conditions for infection and disease are good. Alternatively, the gardener may choose to replace susceptible plants with plants that do not host the disease, or are more tolerant of infection.

Overseas experience has shown that the rust will infect and reduce the vigour and growth rate of young stands of susceptible *Corymbia* and *Eucalyptus* species used in timber production. So far the impact of Myrtle rust on eucalypts in Australia has been minimal. The impact on other crops such as tea tree and other oil producing species is not yet known in Australia, but it is likely that disease control measures, relying heavily on selection of resistant varieties, or judicious use of fungicides, will be needed to assist to maintain product yield and quality. The herbal tea industry has been adversely affected, and it is likely that the native fruit industry may be affected, as species of *Syzygium* seem to be susceptible. Australia's nursery industry is likely to move away from producing highly susceptible hosts as it aims to produce disease free plants for retail sale.

The impact of the rust in the natural environment is unknown although disease levels and damage will likely increase in areas where large numbers of susceptible hosts are found in an ecosystem. Within these ecosystems, different species will vary in susceptibility and the degree to which growth is affected. Areas where ecologically important species are present may justify treatment with fungicides, but this is unlikely to be sustainable in the long term. As susceptible plants are weakened over time by the disease it is likely that there will be a change in the ecology of the areas impacted by the rust. This may affect the food sources of native fauna. Susceptible plants may be replaced in the medium to long term by resistant or non-host plants, which will likely also result in changes to vertebrates and invertebrates in the ecosystem.

Resolving the taxonomic relationship between Myrtle rust and other fungi in the guava rust complex is important for Australia to maintain its phytosanitary measures on imports of risk materials to reduce the risk of entry of other rust species.

Parties to the Emergency Plant Pest Response Deed, including industry, will need to identify and implement strategies to optimise the early detection of any new incursions of fungi in the guava rust complex. Strategies to optimise early detection of new strains or species of Guava rust, in order to optimise the feasibility of eradication should they enter Australia, are elements of emergency preparedness implicit in Deed provisions.

Realistically, with Myrtle rust widespread in northeastern Australia, the likelihood of detecting any additional rust species or pathotypes in that region, before they are also widespread, is extremely low. Subsequent incursions of related members of the guava rust complex increase the risk introduction of pathogenicity genes for new hosts, and of hybridisation, thereby extending the host spectrum and/or aggressiveness of the disease.

4. Objectives of T2M for Myrtle rust

Key investment objectives by the Australian Government for the Transition to Management

Program centre on developing the knowledge and information that will assist the community, land owners and production industries based on Myrtle rust susceptible species to manage the impacts of the disease in urban, production and natural environments. The program focuses on the collection and sharing of information on management options for the disease by chemical means and through determination of potential for breeding host plant resistance. Several projects will be undertaken to determine the identity of the Myrtle rust fungus within the guava rust complex. This is criticial to assist to maintain appropriate biosecurity protection against introduction of other members of the guava rust complex that could hybridise with the existing fungus. Secondly, resolving the specific identity of the pathogen will help to provide tools for the diagnosis of closely related species and ability to detect the development of new pathotypes. The Commonwealth will provide seed funding to establish the infrastructure that can enable continued screening of Myrtaceae for susceptibility and resistance to the disease. Further screening will provide information to improve the basic understanding of the potential impact of Myrtle rust on the natural environment. Analysis of the genetics of resistance will build a foundation for affected industries to establish their own breeding and selection programs for resistance.

A summary of the Australian Government's investment against the themes of the National Transitional Strategy is as follows with further details of the proposed research project in Attachment A:

4.1 Theme 1: Coordination and communication

A national approach to coordination of messages through a transparent, consistent and informative communications process was identified as important to making the initial transition from eradication to living with Myrtle rust. Pending the development of a more suitable web portal, the National Outbreak web site[1] is being used to share information between governments, industry and the community. Mechanisms have also been established by industry groups and affected States to regularly update information on host species, the spread and management of Myrtle rust and how it may affect trade within States, between states and territories, and overseas.

4.2 Theme 2: Immediate disease management

With the move away from eradication in areas where Myrtle rust is established in NSW and QLD the level of investment in ongoing surveillance is significantly reduced. However, there is potential benefit for jurisdictions to undertake targeted surveillance to monitor for the spread of the disease to new areas to assist jurisdictions and industries to implement control measures for new incursions and to meet domestic and international market access requirements.

4.3 Theme 3: Taxonomy and identity of the pathogen

There remains a great deal of scientific uncertainty around the identity of the fungus identified as Myrtle rust. An increase in knowledge, through research and international collaboration, of *Uredo rangelii* is vital to ensure that quarantine conditions applied at Australia's international border are technically justified and appropriate to prevent the entry

[1] http://www.outbreak.gov.au/pests_diseases/pests_diseases_plant/myrtle-rust/index.html

of other fungi in the guava rust complex, and to gain a better understanding of host range and susceptibility of the causal organism in Australia.

The Commonwealth will invest:

- $295,000 for collection of samples and an assessment of the full genome sequencing of selected members of the guava rust complex. Information from this work will help in design of new real-time PCR tests for diagnostic purposes;
- $88,000 in work to determine the phylogenetic relationship between Myrtle rust and other members of the guava rust complex.

4.4 Theme 4: Potential impact and distribution

Observations and studies made of Myrtle rust in Australia have so far confirmed that there is a wide range of host susceptibility to the disease between genera and species. There is also variability within species. In trying to quantify the impacts of Myrtle rust infection on the environment, primary industries and urban communities, an understanding of the cause of variation in species susceptibility is essential. This information will be the key to identifying resistant or tolerant genotypes for commercial deployment to mitigate the impact of the disease. It is intended to explore the potential for a national resistance screening facility to be established to assist industries to develop breeding programs for beneficial species.

The Commonwealth will invest:

- $470 000 to fund the establishment of a National Myrtle Rust Phenotyping Facility to be hosted at the Plant Breeding Institute at Cobbitty to provide high-throughput screening of germ plasm using existing infrastructure.

4.5 Theme 5: Chemical control options

Chemical control of Myrtle rust to manage the impact of the disease in commercial and non-commercial situations will be essential in areas where the disease becomes established. NSW experience shows that a number of fungicides are effective in reducing the disease to very low levels of prevalence. Chemical control of the disease during the early stages of the Myrtle rust response was made under emergency and/or minor use permit provisions by the APVMA. Further development of directions for the use of chemicals and data to extend minor use permits to full use registration by the APVMA is needed.

The Commonwealth will contribute $250 000 to undertake this work.

4.6 Theme 6: Resistance breeding options

Overseas experience has shown that breeding, in addition to selection for resistance in plant species that are highly susceptible to the disease, is necessary to support industries that are dependent on these species. An increased knowledge of sources of resistance in plant species or accessions that could be used to mitigate the impact of Myrtle rust in industry and environmental settings is required. A first step is the discovery of resistance genes to stimulate further research work by industry towards understanding the genetic basis for host plant resistance. The Commonwealth will provide $230 000 towards work in this area.

5. Program Management and Governance

The program will be delivered through a range of contracts under the oversight of a management group consisting of senior representatives of DAFF, Biosecurity Queensland and NSW Industry and Investment. One nominated officer from each body will constitute the management group, which will oversee program establishment, monitor its delivery and consider any triggers arising that necessitate a review of the program. The management group will be chaired by DAFF.

Plant Health Australia will nominate an observer to the management group in recognition of its role as contract manager. PHA will not participate in the decision-making process of the management group but will report to the management group on operational and financial progress in accordance with scheduled program reviews, as well as any reviews that are triggered in the course of the program as a result of unforeseen circumstances.

5.1 Review schedule

Scheduled reviews of the T2M Program by the management group will take place every two (2) months during the first year, then quarterly during the second year. These reviews will focus on ensuring that progress towards delivery of each project against its objectives is on target.

The frequency of review during the first year will assist in further refinement of the National Principles for T2M.

5.2 Program review triggers

Unforeseen circumstances may occur during the delivery of the program that indicates the need for an unscheduled review to assess whether the program remains on track to deliver its outcomes. The following program review triggers have been identified as indicators that program success is at risk:

i Significant deviation from agreed milestones such as early achievement, unanticipated delay, or non-achievement
ii Significant change in pest impacts including any changes in the efficacy of treatment indicating the need to change the planned approach or strategy
iii Emergence of substantial new knowledge that impacts the project and/or program objectives
iv Significant deviation from agreed budget including over-expenditure or savings against any program component or activity area
v Others, including any science or technical advice that comes forward that indicates an impact on delivery of program outcomes.

In the event that one of the above or any other significant issues occurs, the management group will determine the need for a partial or full review of the program in order to deliver program objectives. The management group may consider an appropriate course of action as a result of any review including:

i The agreed program continues without deviation
ii The timelines or scope of one or more activities is modified

iii The resource balance and priority of the program components are modified
iv The program moves to an early (but orderly) closure prior to the original agreed end date.

5.3 Success indicators

The success of the T2M program will be measured by:

- Resolving the taxonomic relationship between members of the guava rust complex and further understanding of the risk of genetic variation of the pathogen in Australia;
- New diagnostic tools to support biosecurity measures and surveillance against further incursions;
- Development of options to assist in managing the disease in commercial, environmental and domestic situations through approved uses of chemicals;
- Investment by industries in research and other work based on information gained through the T2M program, such as ongoing screening for resistance and uptake of resistant varieties of Myrtaceae; and,
- Further investments by other parties in research and establishment of international research networks on Myrtle rust and related rust species affecting Myrtaceae.

6. Complementary activities

The national T2M Program, to operate from July 2011 until June 2013 through the application of $1.5 million of Commonwealth Government funds, will provide multi-jurisdictional benefits, with both immediate outcomes and those which form the basis for longer-term benefits in positioning industries to manage their activities in a future state of living with Myrtle rust.

In recognition of the desire to achieve protection of social amenity and assets within Queensland, the Queensland Government plans to fund complementary activities that focus on increasing knowledge of Myrtle rust under Queensland conditions, and community engagement to reduce the impact of the rust, Attachment B.

Complementary research on elements of managing the impact of Myrtle rust is also being funded by other organisations such as RIRDC ($350 000 over three years, including matching industry contributions), the CRC Plant Biosecurity and the tea tree industry.

These activities will complement activities to be undertaken by the T2M program and the management group will be regularly updated on the progress and outcomes of these activities.

Theme 1	**Coordination and Communication**
Description	The Commonwealth has created a web portal that consolidates and enables access to a wide range of information on Myrtle rust, including advice on its management and impacts, as well as a national host list as generated by field observations from NSW and Qld. The portal content can be expanded by jurisdictions, industry and researchers to include additional information as it comes to hand.
Responsibility	Queensland and/or NSW
Outcomes	Support for national communication activities that help stakeholders to adjust to the presence of the disease and implement long-term management strategies for the disease.
Budget	None beyond existing commitments
Timelines	n/a

Theme 2	**Immediate Disease Management**
Description	Establish and maintain some targeted surveillance in non-infected areas to detect the spread of Myrtle rust to new areas early enough to implement effective disease management measures. It is intended that this remain the responsibility of the Atlas of Living Australia, botanical gardens, land managers, nurseries etc. The Commonwealth is not proposing to invest in this area. The National Plant Biosecurity Cooperative Research Centre is sponsoring a research program to improve understanding of eucalyptus rust epidemiology and host specificity to determine disease impact in Australia and options for disease management.
Responsibility	States and territories, industry
Outcome	Early detection of Myrtle rust in new locations
Budget	None beyond existing commitments and a CRC funded project
Timelines	n/a

Theme 3.	Taxonomy and Identity of the Pathogen
Description	Determine data gaps and resolve the taxonomy of the Myrtle rust fungus within the guava rust complex through a series of collaborative projects with national and international guava rust specialists: Project 3.1 – Sequencing of the full genome of an isolate of Uredo rangelii from Australia and of nine isolates of Puccinia psidii from overseas. This project is intended to involve a consortium of scientists from overseas. Project 3.2 – Cytology of the lifecycle of Uredo rangelii to understand how variation may develop and evolve in the Australian population. Project 3.3 – Revision of holotype (or isotype) collections of members of the Puccinia psidii complex. Project 3.4 – Classification and diversity of the guava rust complex using molecular and morphological characters, involving collection and extraction of nucleic acid of samples from South America. Project 3.5 – Phylogenetic position of the Puccinia psidii sensu lato complex in the Pucciniales.
Responsibility	A Taxonomy Reference Group comprising DAFF, ACERA, University of Tasmania, Royal Sydney Botanical Gardens, Sydney University, NSW and Queensland governments will provide oversight and guidance of these projects. The work is to be undertaken as follows: Project 3.1 – Biosciences Research Division, Knoxfield, DPI Victoria Project 3.2 – CSIRO Ecosystem Sciences Project 3.3 – NSW Department of Industry and Investment Project 3.4 – Qld DEEDI, NSW I&I, Sydney Royal Botanical Gardens and DPI Victoria Project 3.5 – Sydney Royal Botanical Gardens
Outcomes	A genomics approach to differentiation of taxa within the guava rust complex will provide the basis for new diagnostic tools and species definitions that are necessary to maintain Australia's biosecurity policy position to prevent further introduction of other Myrtaceae rusts.
Budget	$383 000 (GST exclusive)
Timelines	Completed by September 2012. Projects to run sequentially.

Theme 4.	Potential Impact and Distribution
Description	Continued screening of hosts for Myrtle rust susceptibility of key environmental and commercial species, including transition to field observations in combination with mass screening. The Commonwealth will explore the potential for a National Myrtle Rust Phenotyping Facility to be hosted at the Plant Breeding Institute at Cobbitty to provide high-throughput screening of germ plasm using existing infrastructure. The funding is aimed at supporting a Postdoctoral Fellowship and a Postgraduate student for two years to strengthen research capability in Myrtle rust biology, pathology and genetics. The proposed work will complement existing projects funded by the Australian Centre of Excellence in Risk Analysis on pathways by which Myrtle rust and other members of the Guava rust complex might enter Australia, as well as modelling of potential Myrtle rust distribution.
Responsibility	University of Sydney, Plant Breeding Institute
Outcomes	A suite of differential hosts of Myrtle rusts to detect and monitor evolution of new races of Myrtle rust, or the unintentional introduction of further member of the guava rust complex. The establishment of a shared Australian Myrtle Rust Testing and Monitoring Facility for use by breeders and researchers to generate greater understanding of the impact and evolution of Myrtle rust in Australia to develop broader ecosystem management strategies.
Budget	$ 470 000 (GST exclusive)
Timelines	Completed by July 2013

Theme 5.	Chemical Control Options
Description	Development of efficacy data for registration or minor use permit of a broad range of fungicides for the control of Myrtle rust in plantation, nursery and garden situations. The Commonwealth will fund a project to screen 20 candidate fungicides across different fungicide groups for efficacy using EPPO Standards. This work will complement RIRDC funded research to establish maximum residue limits (MRLs) for residues in Myrtaceous food crops.
Responsibility	A Fungicide Reference Group comprising DAFF, NSW, Plant Health Australia, Sydney University and RIRDC will provide oversight and guidance for this project. The work will be undertaken through NSW Department of Industry and Investment and will seek potential collaboration with University of Sydney and chemical companies to undertake APVMA registration.
Outcome	Effective chemicals available for use in native bushland and in commercial and domestic uses
Budget	$250,000 (GST exclusive)
Timelines	Completed by December 2012

Theme 6.	Resistance Breeding Options
Description	Research to understand the genetic basis for host plant resistance and to investigate the feasibility of establishing a national resistance screening facility to assist commercial and conservation forestry to develop breeding programs for beneficial species. In support of this objective, the Commonwealth will provide funding for discovery of resistance genes to stimulate further research towards understanding the genetic basis for host plant resistance: Project 6.1 – Genes for resistance in 12 non-Eucalypteae species across Myrtaceae. This study will focus on species of economic importance to rural industries, as well as species for bush regeneration. It complements a similar study funded by RIRDC. Project 6.2 – Molecular markers for genes for resistance in Eucalypteae. The purpose of this study is to develop molecular markers that can be used for rapid screening of economically important species in seed orchards.
Responsibility	A Resistance Breeding Reference Group comprising DAFF, NSW, Queensland, CSIRO, ANU, Sydney University and RIRDC will provide oversight and guidance on these projects. The work will be undertaken by the Research School of Biology, ANU (Project 6.1) and CSIRO Plant Industry (Project 6.2)
Outcomes	Both projects aim to provide potential genes for resistance that can be deployed in existing tea tree and *Eucalyptus* breeding programs.
Budget	$230 000 (GST exclusive)
Timelines	Completed by December 2012

Queensland Government funded project that will focus on increasing knowledge of Myrtle rust under Queensland conditions, and community engagement to reduce the impact of the rust. A total of $750, 000 over 2011/12.

QLD Project 1	**Queensland's Myrtle Rust Program**
Description	The program comprises a suite of activities with the goal of helping residents of Queensland adapt to living with the impacts of myrtle rust. The objectives of the program are to: • Ensure people are aware of myrtle rust and know what to do • Assist industry to operate and trade • Learn more about myrtle rust • Limit impacts on natural and built environmental assets as much as practical Key elements of the program: 1. Disease knowledge and understanding 2. Disease management 3. Legislation and regulation 4. Market access 5. Communication and community engagement 6. Education and training
Responsibility	Biosecurity Queensland
Outcomes	Queensland residents will be able to live with the impacts of myrtle rust.
Costs	$750,000
Timelines	2011/2012