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Known or potential threats from pests and diseases to prospective tree species for high value timber plantings in northern Australia.

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Abstract

The development of a high value timber industry in northern Australia requires high-level, long-term investment. To secure such a commitment, potential investors and growers must be confident of achieving high productivity and/or high quality end product. Pests and diseases, and their effect on tree health, can be major limiting factors to tree establishment and performance. This is especially true where native or endemic species are to be grown. Timber plantings in northern Australia are likely to be at risk from a number of pests and diseases. This includes both native and exotic species already present within the region, and species not yet present but which have potential to cause problems should they arrive. Existing and potential threats are listed and the more serious problems reviewed.

Introduction

The dry tropics region of northern Australia covers a wide geographical area, with comparatively little recorded information on health problems of many of the species to be planted. It is a region of low and highly seasonal rainfall. Low rainfall over long periods will put many tree species, particularly those not endemic to the area, under stress, increasing their susceptibility to pest and disease infestation. For example, it is known that the *Phoracantha* spp. stem borers of Eucalypts synchronise their egg lay with the period of maximum water stress, when low bark moisture content increases survival of young larvae (Hanks *et al* 1999). Periods of high rainfall and high humidity also characterise this region, providing ideal conditions for the increase and spread of many fungal diseases, for example *Cylindrocladium quinqueseptatum.*

In this paper we briefly summarise the impacts of pests and diseases on tree health and the importance of these at different stages of the plantation process. We then discuss the important issue of quarantine and surveillance for incursion of exotic pests in this high risk area of Australia. Finally we list the existing and potential pests (Tables 1 and 2) and diseases (Tables 3 and 4) known for the tree species targeted by this workshop. For the purposes of this paper tree species will be considered in three groups:

- Species of Meliaceae
- Species of Eucalypt
- Other timber species

We provide brief notes on the damage and impact of the more significant of these agents.

Impacts of Pests and Diseases on Tree Health

Pests and diseases can affect the survival, growth rate and form of individual trees, as well as the quality and value of timber produced (Wylie and Peters 1993; Speight and Wylie 2001).

Survival – Severe and/or repeated damage from insects or diseases can kill trees outright, or make them more susceptible to other mortality factors

Growth rate – Defoliation reduces a tree's ability to photosynthesise, ultimately restricting growth

- Leaf feeders, including many caterpillars, leaf feeding beetles and sawfly larvae, feed directly on and consume leaves and growing tips.
- Sap-suckers remove sap from leaves and soft stems, causing chlorosis, necrosis, distortion and leaf fall.
- Leaf and shoot blight diseases cause necrosis of leaf tissues, shrivelling and distortion of twigs and growing points.

- Root rots destroy the root system leading to chlorosis, defoliation and death.

Form – Loss and damage of leaders and stems can result in the formation of multiple leaders, distorted stems and bushy form.

- Tip and shoot feeders including sap suckers feed directly in the growing tips.
- Stem borers and branch pruners, including longicorn borers and wood moths, weaken stems and lead to breakage
- Diseases, including cankers, blights and bacterial wilts weaken and deform stems.

Quality and value of timber produced - Pests and diseases affecting the trunk impact on yield and quality of timber.

- Longicorn borers and wood moths leave tunnels, large holes and/or resin canals and may act as sites of entry for stains and rots.
- Bark and ambrosia beetles colonise wound sites and stain the timber.
- Termites, root rots and heart rots are associated with cavities, pipes and decaying wood.

The impact of pests and diseases needs to be considered at all stages in the development of a plantation industry (Speight and Wylie 2001).

- During the **planning stage** information on actual and potential threats to tree health can provide valuable input into species selection and species/site matching.
- During the **nursery stage** pest and disease problems can lead to poor survival and poor health of planting stock. With good monitoring and early intervention nursery pests and diseases can be managed effectively. To restrict the further spread of pests and diseases it is important to ensure material for planting out or for transfer between regions is clear of pests and diseases.
- **After planting**, trees should be inspected regularly (at least annually) for pest and disease problems by experienced personnel. Ongoing monitoring and surveillance inspections during the life of the planting enables early detection of damage symptoms, identification of patterns of activity, and assessment of the incidence and impact of natural enemies. Early detection of changes in tree health and potential problems, before they became serious allows remedial action to be undertaken early in the progression of a problem, rather than once the problem has reached critical levels (Speight and Wylie 2001, Stone *et al* 2001). Recognising patterns of pest and disease activity can have predictive value for some species. For example, some scarab beetle species swarm following storm rain, and can defoliate their eucalypt hosts. If those beetles are known to be present, extra surveillance at the appropriate time, and early intervention, can reduce or prevent damage.
- Problems **during and after harvest** are most commonly caused by insect pests. Of greatest concern are scolytid beetles, which are major pests of unseasoned timber worldwide.

As well as having a primary impact on tree health, pests and diseases can have secondary impacts, through compounding existing problems. Trees that are stressed may be more susceptible to, and less able to recover from, a subsequent insect or disease infestation. Often more than one pest or disease can be active at any one time.

Quarantine

Northern Australia is viewed as a high-risk area for the entry of many exotic pests and diseases. Australian Quarantine Inspection Service (AQIS) and Northern Australia Quarantine Service (NAQS) actively survey these areas but concentrate on pests of agricultural and to a lesser extent horticultural significance and do not target timber species or forest areas. Some species of exotic timber insects have the potential to devastate both native and plantation forests, with serious economic impacts on the timber industry and other land management agencies. Several of the more serious threats have potential to damage both agricultural, horticultural and tree crops (eg *Zeuzera coffeae*, *Helopeltis* spp.).

The primary source area of potential pests and diseases that may enter northern Australia are likely to be PNG, Indonesia, Malaysia and the Philippines (Floyd *et al*. 1998). These areas pose a significant threat in terms of their proximity, the amount of human trade and movement, the presence of significant areas of forestry, and the fact that many tree species present in these areas are the same or related to those targeted for northern Australia. The amount of both international and local traffic to and within this area continues to grow, further increasing the risk of incursion. The main pathways for entry of pests and diseases are in timber or soil, or on foliage of living plants.

Surveying for incursions of exotic pests and diseases is particularly difficult because of the large scale and general remoteness of the area under consideration and the dispersed distribution of plantings within this area. Further, there are often endemic insect and pathogen species that are closely related and/or have similar damage symptoms. This not only makes correct diagnosis difficult, but makes eradication attempts virtually impossible to pursue. Endemic species of *Helopeltis* and *Amblypelta* are already present in this country, while damage from the Cerambycids *Oxymagis horni* and *Celosterna scabrator* would be very difficult to distinguish from that of Australia's many endemic species with similar feeding habits (Floyd *et al*. 1998). The cost of eradication or control of any damaging exotic agent could be millions of dollars added to the loss of resource. It is now recognized in many countries that early detection is vital in preventing huge economic and resource losses, enabling eradication to be attempted and containment measures to be initiated. One forestry pest for which there is an established trapping program in Australia is the Asian Gypsy Moth (*Lymantria dispar).* As part of this program pheromone traps have been established and are regularly monitored at 29 ports throughout the country. However this does not include northern Queensland or the Northern Territory.

The suite of potential pests and diseases is likely to increase as the distribution and scale of overseas plantings expands, and there are increasing incidents of pests and diseases switching to new hosts. Recently two separate Cossid borers have been recorded as pests of Eucalypt trees in South Africa and Chile, neither of which had been recorded feeding on Myrtaceae previously (Solomon Gebeyuhu, University of Pretoria, pers comm.).

Internal quarantine within the region is also critical for the transport of material to planting sites and between regions.

Conclusion

The dry tropics of northern Australia covers a wide geographic area, with comparatively little recorded information on health problems of many of the tree species to be planted. Adequate pest and disease surveys have not been conducted for most species, especially for northern regions. For other species, eg *C. citriodora*, intensive disease surveys in northern Queensland have only been done in the early stages of plantation development, and there are, no doubt, many other fungal pathogens yet to be identified. Long-term management of these pests and diseases requires knowledge of the biology; impact and management options for those species already present, and those that threaten from offshore.

In establishing trials and plantings in this region the following measures will promote tree health and contribute to our understanding of the distribution and impact of pests and diseases.

- Ensure accurate matching of tree species to site and carry out regular site maintenance to promote tree vigour and reduce stress. This will improve tree tolerance and resistance to pest and disease attack. Weed control and fertilizer application can also significantly improve tree health following pest or disease damage episodes (Stone and Birk 2001).
- Include routine health surveillance of plantations to assess the incidence and severity of pests and diseases over time and evaluate the impacts on plantation productivity. This will provide early warning of problems as they arise.

- Establish a comprehensive health data base to record pests, diseases, impacts, geographic and temporal occurrence and other factors in relation to the tree species grown. Any plantings in this area provide an opportunity to increase our knowledge of pest and disease interactions with trees, particularly in plantation situations. Such a database will be crucial for planning future plantations, eg matching species to site, and developing a plantation risk rating.

Table 1: Known insect pests of high value timber species in the dry tropics of northern Australia.

Tree species	Insect	Type of Damage
Meliaceae[1]		
Cedrela odorata *Chukrasia tabularis* *Chukrasia velutina* *Khaya nyasica* *Khaya senegalensis* *Swietenia humilis* *Swietenia macrophylla*	*Hypsipyla robusta* Lepidoptera *Xylotrupes gideon* Coleoptera	Shoot borer Stem and branch feeder
Eucalyptus		
Corymbia citriodora	*Cryptocephalus speciosus* Coleoptera *Phoracantha acanthocera* Coleoptera *Phoracantha mastersi* Coleoptera *Phoracantha solida* Coleoptera *Mictis profana* Hemiptera	Leaf chewer Stem borer Stem borer Stem borer Sap sucker
Eucalyptus camaldulensis	*Epholcis bilobiceps* Coleoptera *Liparetrus discipennis* Coleoptera *Hyalarcta huebneri* Lepidoptera *Endoxyla cinerea* Lepidoptera *Phoracantha solida* Coleoptera *Mictis profana* Hemiptera	Defoliator Defoliator Defoliator Stem borer Stem borer Sap sucker
Eucalyptus grandis	*Epholcis bilobiceps* Coleoptera *Endoxyla cinerea* Lepidoptera *Phoracantha acanthocera* Coleoptera *Phoracantha solida* Coleoptera *Eriococcus coriaceus* Hemiptera *Chrysophtharta cloelia* Coleoptera *Cardiaspina fiscella* Hemiptera *Cardiaspina maniformis* Hemiptera *Mictis profana* Hemiptera	Defoliator Stem borer Stem borer Stem borer Sap sucker. Leaf chewer Defoliator Defoliator Sap sucker
Eucalyptus pellita	*Chrysophtharta cloelia* Coleoptera *Epholcis bilobiceps* Coleoptera *Geloptera miracula* Coleoptera *Phoracantha acanthocera* Coleoptera *Phoracantha solida* Coleoptera *Pergagrapta polita* Hymenoptera *Rhyparida discopunctata* Coleoptera	Defoliator Defoliator Leaf chewer Stem borer Stem borer Leaf chewer Leaf feeder
Eucalyptus tetrodonta	No information	
Eucalyptus spp.	*Cardiaspina* sp. Hemiptera *Amorbus* sp. Hemiptera Microhymenoptera Hymenoptera *Perga* sp., *Pergagrapta* sp. Hymenoptera	Sap sucker Shoot sucker Leaf/stem galler Defoliator
Other species		
Acrocarpus fraxinifolius	No information	
Dalbergia	*Nipaeoccus viridis* Hemiptera	Sap feeder
Pterocarpus indicus	No information	
Santalum spp.	*Coenotes eremophilae* Lepidoptera Diaspid scale insects Hemiptera *Graptostethus servus* Lepidoptera *Delias argenthona* Lepidoptera	Defoliator Sap sucker Flower feeder Defoliator
Tectona grandis	*Hyblaea puera* Lepidoptera	Leaf chewer
Terminalia belerica	Longicorn beetles Coleoptera	Stem borer
Terminalia microcarpa	Longicorn beetles Coleoptera	Stem borer

[1]These insects are likely to be a problem on all these species, though the degree will vary.

Table 2: Potential insect pests of high value timber species in the dry tropics of northern Australia.

Tree species	Insect	Type of Damage
Meliaceae		
Cedrela odorata		
Chukrasia tabularis		
Chukrasia velutina		
Khaya nyasica		
Khaya senegalensis		
Swietenia humilis	*Zeuzera coffeae* Lepidoptera	Twig &stem borer
Swietenia macrophylla	*Zeuzera coffeae* Lepidoptera *Acrocercops spp* Lepidoptera	Twig &stem borer Leaf miner
Eucalyptus		
Corymbia citriodora	*Celosterna scabrator* Coleoptera	Root and stem borer
Eucalyptus camaldulensis	*Strepsicrates rothia* Lepidoptera *Zeuzera coffeae* Lepidoptera	Leaf roller Twig &stem borer
Eucalyptus grandis	*Celosterna scabrator* Coleoptera *Zeuzera coffeae* Lepidoptera	Root and stem borer Twig &stem borer
Eucalyptus pellita	*Amblypelta cocophaga* Hemiptera *Oxymagis horni* Coleoptera	Shoot feeder Stem borer
Eucalyptus tetrodonta		
Eucalyptus spp.	*Helopeltis* spp. Miridae	Sap sucker
Other species		
Acrocarpus fraxinifolius		
Dalbergia spp.		
Pterocarpus indicus		
Santalum spp.		
Tectona grandis	*Xyleutes ceramica* Lepidoptera *Zeuzera coffeae* Lepidoptera *Eutectona machoeralis* Lepidoptera	Wood borer Twig &stem borer Leaf skeletoniser
Terminalia belerica	*Oxymagis horni* Coleoptera *Zeuzera coffeae* Lepidoptera	Stem borer Twig &stem borer
Terminalia microcarpa	*Oxymagis horni* Coleoptera	Stem borer

Table 3: Known diseases of high value timber species in the dry tropics of northern Australia.

Tree species	Disease	Type of Damage
Meliaceae		
Cedrela odorata		
Chukrasia tabularis		
Chukrasia velutina		
Khaya nyasica		
Khaya senegalensis	*Phellinus noxius* *Rigidoporus vinctus*	Root rot Root rot
Swietenia humilis		Twig &stem borer
Swietenia macrophylla		Twig &stem borer Leaf miner
Eucalyptus		
Corymbia citriodora	*Quambalaria pitereka* *Mycosphaerella spp* Armillaria spp *Phellinus noxius* *Fusicoccum aesculi* *Phaeothyriolum microthyroides* *Cylindrocladium quinqueseptatum*	Foliage blight Foliage spot Root rot Root rot Stem decay Foliage spot Foliage blight
Eucalyptus camaldulensis	*Mycosphaerella* spp (*M. cryptica*) *Pheaophleospora eucalypti* *P. epicoccoides* *Quambalaria eucalypti* *Phellinus spp.* *Ganoderma spp.*	Foliage spot Foliage blight Foliage blight Shoot blight Stem decay Stem decay
Eucalyptus grandis hybrids	*Mycosphaerella* spp (*M. cryptica*) *Pheaophleospora eucalypti* *P. epicoccoides* *Quambalaria eucalypti* *Phellinus spp.* *Ganoderma spp.*	Foliage spot Foliage blight Foliage blight Shoot blight Stem decay Stem decay
Eucalyptus pellita	*Armillaria* spp. *Aulographina eucalypti* *Cercospora* spp. *Coniella fragariae* *Coniella* spp. *Coniothyrium* sp. *Cryptosporiopsis* sp. *Cylindrocladium quinqueseptatum* *Phaeophleospora epicoccoides* *Mycosphaerella* spp. *Phellinus noxius* *Phellinus* spp.	Root rot Foliage spot Foliage blight Foliage blight Foliage blight Foliage spot Foliage spot Foliage blight Foliage blight Foliage spot Root rot Stem decay
Eucalyptus tetrodonta	*Phellinus* spp.	Stem decay
Eucalyptus spp.		
Other species		
Acrocarpus fraxinifolius		
Dalbergia spp.		
Pterocarpus indicus		
Santalum spp.		
Tectona grandis		
Terminalia belerica		
Terminalia microcarpa		

Table 4: Potential diseases of high value timber species in the dry tropics of northern Australia.

Tree species	Disease	Type of Damage
Meliaceae		
Cedrela odorata		
Chukrasia tabularis	*Phytophthora nicotiane*	Foliage blight
Chukrasia velutina		
Khaya nyasica	*Cylindrocladium parasiticum*	Foliage blight
Khaya senegalensis	*Cylindrocladium parasiticum*	Foliage blight
Swietenia humilis		
Swietenia macrophylla		
Eucalyptus		
Corymbia citriodora	*Corticium salmonicolor* *Puccinia psidii*	Stem canker Foliage rust
Eucalyptus camaldulensis	*Corticium salmonicolor* *Phaeophleospora destructans* *Cryphonectria cubensis* *Coniothyrium zuluense* *Puccinia psidii*	Stem canker Foliage blight/defoliation Stem canker Stem canker Foliage rust
Eucalyptus grandis hybrids	*Corticium salmonicolor* *Phaeophleospora destructans* *Quambalaria eucalypti* *Cryphonectria cubensis* *Coniothyrium zuluense* *Puccinia psidii*	Stem canker Foliage blight/defoliation Foliage blight Stem canker Stem canker Foliage rust
Eucalyptus pellita	*Corticium salmonicolor* *Cryphonectria cubensis* *Coniothyrium zuluense*	Stem canker Stem canker Stem canker
Eucalyptus tetrodonta	*Cryphonectria cubensis* *Coniothyrium zuluense*	Stem canker Stem canker
Other species		
Acrocarpus fraxinifolius		
Dalbergia spp.		
Pterocarpus indicus		
Santalum spp.	Spike disease	
Tectona grandis	*Fusarium pallidoroseum* *Fusarium solani*	Basal canker Basal canker
Terminalia belerica		
Terminalia microcarpa		

Currently important insects

***Chrysophtharta cloelia* Stal (Coleoptera: Chrysomelidae) – leaf beetle**

Both adults and larvae feed on the foliage of susceptible Eucalypt species, including *E. pellita* and *E. grandis.* Larvae feed on soft young foliage and developing buds in the upper crown, giving a characteristic broom top appearance. Adults leave distinctive scallop feeding marks on the margins of older leaves. Impacts are most severe on younger trees less than three years age.

***Endoxyla cinerea* (Tepper) (Lepidoptera: Cossidae) - Giant Wood Moth**

Giant wood moth is a widespread and serious pest of plantation grown eucalypts in Queensland and northern NSW (Wylie and Peters 1993, Lawson *et al* 2002). It is not known how far from the coast these insects occur. Currently they are known from Davies Creek, east of Mareeba, but the western extent of their distribution is unknown. Larvae bore into the tree trunk excavating a large tunnel in the heartwood. They remain within this tunnel for 12 months feeding on the callus tissue formed at the point of entry. Damage from the larvae leads to a reduction in both plantation productivity and wood quality. Attacked stems are weakened by the damage and by the activities of yellow tailed black cockatoos searching for the larvae.

***Epholcis bilobiceps* (Fairmaire) (Coleoptera: Scarabeidae)**

Adult beetles feed on Eucalypt leaves and are a major threat to young Eucalypt plantations, including *E camalduensis, E. grandis* and *E. pellita* (Elliott *et al.* 1998). When present in large swarms they can completely defoliate young and mature trees. Adults feed during the night and are most active in summer and early autumn. During daylight hours they rest on tree stems and undergrowth. The larvae are thought to feed on grass roots. Their known distribution is from Iron Range to Townsville in north Queensland.

***Hyblaea puera* Cramer (Lepidoptera: Hyblaeidae) – Teak defoliator**

The teak defoliator *Hyblaea puera* is the most serious pest of teak throughout the tropics. It is widely distributed through the Americas, southern and East Africa and much of south east Asia and the Pacific, including northern Queensland (Speight and Wylie, 2001). Defoliation retards growth and impacts on tree form if buds are killed. The frequency of severe defoliation is high in stands aged 11 – 45 years and is at its maximum in stands 21 - 30 years old.

***Hypsipyla robusta* (Moore) (Lepidoptera: Pyralidae) - cedar shoot borer**

These insects are amongst the most economically important pests in tropical forestry, virtually preventing the cultivation of mahoganies (*Swietenia* spp., *Khaya* spp.), cedars (*Cedrela* spp., *Toona* spp.) and other valuable Meliaceae throughout the World (Cameron and Jermyn 1991, Newton *et al*. 1993). *H. robusta* occurs in Australia and parts of the Pacific and south east Asia, while related species are present in the Americas and Africa. Tunneling by the larvae in the shoots causes shoot mortality, growth reduction, branching and poor tree form. Repeated attacks can result in tree death. Trees are attacked from the nursery stage through to maturity, but attacks up to the pole stage are most critical from a silvicultural view point (Griffiths *et al* 2001, Newton *et al*. 1993).

The insect is distributed along east coast Australia as far north as Iron Range, and has also been recorded from Weipa and Darwin. However the full distribution in northern Australia is unknown. The other Australian host, *Xylocarpus* spp. mangroves, extend from coastal Queensland through coastal areas and tidal creeks of the NT and northern WA to at least 15°S. There is considerable variability between different host species in their susceptibility to and recovery from insect attack. Of five species planted out in large-scale trials in southeast Qld, *Toona ciliata* was the most heavily damaged and consequently of poorest form, while *Khaya senegalensis* was the least damaged. Both *C. odorata* and the *Chukrasia* spp. show a

better ability to recover following damage, producing fewer branches and retaining better form after damage. *Swietenia macrophylla* performed poorly in this trial because of frost damage but generally received low damage.

Nipaecoccus viridis (Hemiptera:)
This insect has been recorded feeding on all plant parts of *Dalbergia* sp, cause curling and stunting of terminal growth, abortion of flowers, yellowing of leaves, fruit drop, wilting, dieback, sooty mould.

***Phoracantha* spp. (Coleoptera: Cerambycidae) - longicorn beetles**
Three species of Phoracantha are important pests of Eucalypts in Queensland, *P. solida* (two hole borer), *P. acanthocera* (bullseye borer) and *P. mastersi* (ringbarking longicorn) (Elliot *et al*. 1998, Lawson *et al.* 2002). Of these *P. solida* is the most widespread and consistent pest. Larvae of these beetles bore into the cambium, initially feeding on the phloem and later tunnelling into the heartwood to pupate. Their damage leads to reductions in wood quality, through physical damage by the larvae, fungal staining and wood rot.

Generalist problems

Ambrosia beetles

Ambrosia beetles are major pests of unseasoned timber. Adults bore in the sapwood and heartwood of stressed, wounded, dying or recently dead trees, freshly felled logs or, occasionally, newly sawn timber. Their tunnels and the associated fungal staining of the wood can rapidly and severely degrade the timber (Peters *et al*, 1996). Disinfestation of borer-affected logs is extremely difficult. Therefore, for high value logs it is better to limit the opportunities for infestation. Careful attention taken during logging will limit wounding and infestation of remaining trees. Rapid processing after felling and kiln drying or air drying of material in a protected environment will further limit the risks of infestation.

Termites

Subterranean termites are widespread through much of the region and some pose a significant threat to tree species. Most termites feed in existing wounds and scars and areas of rot and decay in the bark, sapwood, heartwood and roots of trees of all ages. Their damage often results in further decay and can contribute to tree death. Other species, in particular the giant northern termite, *Mastotermes darwiniensis*, will kill young trees outright. They are the most widespread and voracious of the native termite species. They have a wide radius of operation around the nest and new nests form easily by budding off from the main colony. Large trees stumps retained before planting pose a potential site of infestation.

Potentially important insects

***Amblypelta cocophaga* China (Hemiptera: Coreidae) - shoot feeding bug**

This insect is a major pest of *Eucalyptus deglupta* but also attacks a number of other forest tree species including *E. pellita*, and a range of agricultural crops (Bigger 1988). It is recorded from PNG and the Solomon Islands. Nymphs and adults are sap suckers, feeding on young, unhardened shoots. Attacked shoots wilt and dieback leading to very dense bushing and slow growth. Australia already has three indigenous species of *Amplypelta*. Insects can be carried as eggs or nymphs on fruit or foliage of their hosts.

***Helopeltis* spp. (Hemiptera: Miridae) – mosquito bugs**

Helopeltis spp. have a wide range of horticultural and forest hosts including Eucalyptus spp. (Stonedahl 1991). They are widely distributed through south east Asia and the Pacific, including PNG and Timor. One species, *H. clavifer* is endemic to Australia. Both adult and nymphs are sap suckers, feeding on leaves, stems and fruit of their hosts. Feeding damage leads to discolouration and tissue death around the feeding point. Damage to the shoots and leaves results in wilt and tip dieback. The insects can be transported in infested fruit and other plant material, and have potential for natural movement through flight and wind.

***Lymantria dispar* (Linnaeus) (Lepidoptera: Lymantridae) – Asian Gypsy Moth**

The Asian Gypsy Moth, originating from Asia, has a wide host range and is known to feed on foliage of over 650 tree and plant species in forestry, horticulture, amenity plantings and wilderness areas (Liebhold *et al*. 1995). Heavy infestations may result in complete defoliation of trees. Repeated defoliation can kill trees directly, or reduce vigour leading to secondary insect or disease problems. AGM is of great concern due to its potential for rapid establishment and spread over large areas. Eggs can be transported on ships and cargo. Females can disperse up to 30km (Wallner 1996).

***Oxymagis horni* (Heller) Coleoptera: Cerambycidae –** Stem boring beetle

This insect has a wide host range including *E. pellita* and *Terminalia* spp. (Bigger 1988). It occurs in PNG and the Solomon Islands where it has become an important pest in eucalypt plantations, especially during establishment. Larvae tunnel into the branches and stem, pruning off branches and weaken the stems of smaller trees. Immature stages can be transported in timber or wood products.

***Xyleutes ceramicus* (Walker) - Teak beehole borer**

Occurs from Myanmar eastward, through Indonesia, the Philippines and PNG into the Solomons. It is not known to extend further into the Pacific (Bigger 1988). In teak, attack may take place in trees of any age. Bee holes persist in the timber and accumulate with tree age, averaging 65 per tree in 60 year old trees, with numbers as high as 511 recorded in older trees (Bigger, 1998). A recent record of this insect has been made from Cape York (ANIC 1992).

***Zeuzera coffeae* Nietner (Lepidoptera: Cossidae) - Branch boring caterpillar, red borer**

This insect has a wide host range, including several Eucalypt species (*E camalduensis*, *E. grandis*), *Swietenia spp., Terminalia spp. and Tectona grandis* (Beeson 1961, Bigger 1998). It is widely distributed through south east Asia and the Pacific (including PNG), where it is principally a pest of coffee, tea and tobacco, but is increasingly becoming a serious problem in young tree plantations, particularly Eucalypts (Streets 1962). Larvae bore into the cambium, and can completely girdle the stem or branch causing the plant to die back to this point. Infested stems and branches are prone to windbreak while small trees can be killed outright. Immature stages can be transported in young seedlings as well as dispersing naturally by flight and wind.

Currently important diseases

***Quambalaria pitereka* (Walker & Bertus) JA. Simpson – Ramularia shoot blight**

Ramularia shoot blight now has become a serious constraint to further expansion of *Corymbia* plantations Carnegie 2002). The disease infects the young growing shoots and tips, causing spotting, necrosis and distortion of young, expanding leaves and shoots. Diseased shoots and leaves are shiny white in colour as a result of a massive development of the fungus pushing through and rupturing the waxy cuticle. On leaves neighboring pustules fuse to form large irregular lesions, which often develop along one edge resulting in distortion and twisting of the leaf. Heavily infected trees are often stunted and multi-branched and are characterized by shoot dieback. Trees can grow through the damage, but some remain suppressed.

***Mycosphaerella* and *Pheaophleospora* leaf diseases**

These leaf spot diseases produce spots ranging in size from 5-12mm. The colour, appearance and location of these spots varies on different host species. Under heavy infestation spots join together often causing the leaves to crinkle and resulting in premature leaf fall. The pathogens are common on a number of *Eucalyptus* species throughout Queensland and are more apparent in wet conditions.

***Coniella fragariae* (Oudem.) B.Sutton**

Coniella fragariae occurs in both plantations and nurseries in northern Queensland (Carnegie 2002). It has a wide host range and is more commonly found during the wetter months. Spores are spread by rain splash with disease development being favoured during humid conditions. The disease causes circular yellow-brown spots, principally on older leaves of *E. pellita* and other Eucalypt species. Spots initiate from the leaf margin and spread to form large blights, with small black fruiting bodies visible on the upper surface. Heavily infested leaves can be completely covered by these blights and are shed prematurely.

***Cylindrocladium quinqueseptatum* Boedijn & Reitsma - Cylindrocladium leaf blight**

Cylindrocladium leaf blight (CLB) is one of the more severe fungal diseases impacting on plantation development in north Queensland and the Northern Territory (Carnegie 2002). It is more commonly found during the wet season and can build up rapidly following rains. CLB typically affects the foliage and new shoots of young trees and is characterised by the association of dark, water-soaked, rapidly-expanding fungal lesions with distorted leaves, premature leaf shedding and formation of cankers on young stems.

Potentially important diseases

***Corticium salmonicolor* Berkeley and Broome – Pink Disease**

C. salmonicolor forms several distinct growth forms on stems and branches including "cobwebs", "pustule" and "pink encrustation" (Floyd *et al.* 1988). The main damage comes from the development of cankers that kill the cambium and girdle branches causing shoot dieback. Affected trees often break in high winds, and broken tops and main branches distributed through a planting are characteristic of this disease. The disease has a wide host range, including eucalypts, acacias and numerous fruit trees. The disease is widely distributed through the tropics and subtropics and is already present in Australia (NSW) though not on Eucalypts. Variation in the susceptibility of species, provenances and clones has been observed in Brazil (Floyd *et al.* 1998).

***Cryphonectria cubensis* (Bruner) Hodges – Eucalyptus canker**

This pathogen is restricted to the family Myrtaceae. It is a widespread and important pathogen of eucalypts in the tropics and subtropics. The disease produces large basal cankers that reduce growth rates and can girdle trees, leading to mortality during the first 2-3 years of growth. In older trees the cankers can extend several metres up the bole. The disease is present on Eucalypts in WA but is still considered a quarantine risk for northern Australia (Floyd *et al*, 1988).

***Puccinia psidii* Winter – Guava rust**

This disease attacks foliage, flowers, shoots and fruits of a number of species within the family Myrtaceae. Infection leads to the formation of reddish pustules, and when severe can cause heavy defoliation, growth reduction and death. Response to infection varies between species, within species and according to age, being less evident on older plants. The disease is present in South and Central America and has caused severe damage to several Eucalypt species grown in Brazil. Once detected onshore the disease is expected to spread very rapidly and would be impossible to eradicate. The impact on native vegetation is impossible to predict but may be severe (Floyd *et al.* 1988)

Spike disease – Sandalwood

Spike disease has been a major scourge of sandalwood, taking a heavy toll of trees. The causal organism of the disease is a phytoplasma. Tips of shoots start bearing little leaves, causing a bushy appearance. At later stages the shoots become bare and sterile and the diseased plants add little heartwood. Trees affected by spike disease usually produce poor quality wood and oil.

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