

Dutch elm disease

A biosecurity threat to Australian elm trees

Background

Dutch elm disease (DED), caused by the fungi *Ophiostoma ulmi* and *Ophiostoma novo-ulmi*, is considered one of the most devastating tree diseases in the world. These pathogens cause a wilt disease of elm trees (*Ulmus* spp.) and are vectored between trees by bark beetles. The fungus can also spread from infected to healthy trees by root grafts. The pathogens are not known to occur in Australia but *O. novo-ulmi* and its vector, the European bark beetle (*Scolytus multistriatus*), have been present in New Zealand since 1989. This bark beetle has been present in Australia since 1974. The presence of the disease in New Zealand, and the failure to eradicate the disease in that country, is of particular concern to Australia. Elms in Australia are an important feature of many urban landscapes and have considerable amenity and heritage value. They have often been planted in Avenues of Honour to commemorate Australia's fallen soldiers. Australia now has one of the finest populations of European elm trees remaining in the world. DED, if introduced, may have a large impact on these Australian elms.

Pathogens

The fungus, *O. ulmi*, a relatively weak pathogen of elms, was responsible for the first outbreak of DED in Europe in the early 1900s. The much more aggressive pathogen *O. novo-ulmi* was described in 1991. Both these pathogens are thought to have originated separately in Asia, with limited hybridization occurring between the two species. There are two subspecies of *O. novo-ulmi*, referred to as the Eurasian (EAN – *O. novo-ulmi* subsp. *novo-ulmi*) and the North American (NAN – *O. novo-ulmi* subsp. *americana*) races. The latter race is present in New Zealand. A closely related fungus, *Ophiostoma himal-ulmi*, has been described from the Himalayas but has not been associated with naturally diseased elms. However if this species did enter Australia it may also pose a threat to elms in this country.



Young elm infected with DED. Photo by Chad Giblin, Department of Forestry Research, University of Minnesota.

Symptoms

DED is a vascular wilt disease and symptoms vary depending on whether trees were infected through beetle feeding wounds or through root grafts. Where beetles are involved, trees show wilting, curling and yellowing of one or more branches at the top of the tree. If the disease progresses rapidly, infected trees may only survive for two to three years, or they may survive for years with the number of wilted branches increasing annually.

Where a tree has been infected through root grafts, disease develops more rapidly, with wilting first appearing in the lower branches and progresses upwards.

A typical internal symptom from infection through beetle feeding wounds is the presence of brown longitudinal streaks in the outer sapwood of twigs and small branches. These can be seen by peeling off the bark from a dying twig or branch.

In young trees and seedlings there is wilting and curling of leaves within one week of infection; all leaves may curl and die after five weeks.

Host Range

Most *Ulmus* spp. from Europe and North America are highly susceptible. Some Asian elms have a greater level of resistance. DED has been recorded on the genus *Zelkova* but it is highly resistant.

Spread

There are many bark beetles which are potential vectors of DED spores, but only a few are regarded as significant vectors. The most important vector present in Australia is the European elm bark beetle, *S. multistriatus*. Other Scolytid beetle vectors are not known to be present in Australia. Beetles move into a new area by flying short distances or by being moved in infested timber (especially where the bark is retained) used for furniture, wood packing material, dunnage or as firewood.

Root grafts commonly form between closely planted elm trees, especially elms of the same species. DED fungi can spread from diseased trees to healthy trees by these grafts. The fungus can kill an entire avenue of trees in this way.

The disease may be dispersed with *Ulmus*, *Zelkova* and *Planera* nursery stock and with seed of these genera. Elm flowers (fresh) and bark on



DED dieback. Photos by William M. Brown Jr. (above) and Joseph OBrien, USDA Forest Service (below), both Bugwood.org.

timber, chips and handicrafts can also carry the pathogen. It is possible that DED pathogens can be spread on non-disinfested pruning tools.

Biology

Adult female bark beetles are attracted to stressed or dead elm trees or to elm logs in firewood piles. They burrow beneath the bark and create nuptial galleries where the eggs are laid. The eggs hatch into larvae which feed by making tunnels (galleries) in the tree. The egg galleries run with the wood grain, whereas the larval galleries extend across the wood grain. If the tree or log was infected with DED, the fungus produces sticky spores in the galleries. When the new generation of beetles emerge (usually in the spring) they carry the sticky spores on their bodies. These beetles fly to a healthy tree and feed in the crotches of tender twigs. This results in the systemic infection of the tree. DED is a typical vascular wilt disease in that it invades the tree by the movement of mycelium and spores in the xylem vessels. As infected trees decline they become more attractive to female beetles which eventually develop broods in them.

Management

Some other diseases (bacterial wetwood, Dothiorella wilt, phloem necrosis, *Verticillium* wilt) and disorders (e.g. possum damage, elm leaf beetle feeding wounds and mechanical damage) may cause similar wilting symptoms to DED. Therefore, samples from a suspect tree must be submitted to a diagnostic laboratory to confirm the presence of DED.

Australia has not been subjected to DED, although a vector of the disease has been present since 1974. If a DED pathogen did enter Australia eradication will be difficult but may be achievable.

Production nurseries are important pathways for the potential entry and spread of DED. As the exclusion of the pathogen from nurseries will be a key strategy, those nurseries producing elm trees need to adopt sound nursery hygiene procedures through best management practice. Early detection and rapid diagnosis of suspect plants will be essential if the disease is to be eradicated. If eradication is not feasible a containment program may be implemented to prevent the pathogen moving to new areas. Nurseries will be closely monitored and movement of nursery stock may be restricted.



Nursery stock infected with DED (top - Benjamin Held, Dept. of Plant Pathology, University of Minnesota); **internal vascular discoloration** (bottom by William Jacobi, Colorado State University, Bugwood.org); **exposed vascular tissue of branch with dieback** (bottom insert - Y.P. Tan, DAF);

In countries where the disease is present, management is based on a community surveillance and sanitation program, which involves rapid felling of diseased trees and sanitary disposal of all wood. Containment of the disease can include pruning infected trees and injection of trees with a systemic fungicide. Root grafts are also severed between infected and healthy trees. Bark beetle populations can be managed using pheromone traps and insecticides but this must not replace sanitation procedures.

If you see anything unusual call the Exotic Plant Hotline on 1800 084 881. More detailed information on the biology and management of the disease is available in the Dutch Elm Disease Contingency Plan, produced by Plant Health Australia and the Nursery and Garden Industry Australia (NGIA) as part of the Nursery Industry Biosecurity Plan. A copy of this plan can be obtained from the NGIA website.

This document was prepared by Ken Pegg and Andrew Manners (Agri-science Queensland, Department of Agriculture and Fisheries, Ecosciences Precinct, GPO Box 267, Brisbane QLD 4001) as part of NY15002 Building the resilience and on-farm biosecurity capacity of the Australian production nursery industry in 2016. Thanks go to Lindy Coates (DAF) for helpful comments on previous versions of this factsheet.



European elm bark beetle galleries (top right - Scott Cameran, Advanced Forest Protection, Inc.); **close up of European elm bark beetle** (bottom right - Natasha Wright Cook's Pest Control); **damage caused by elm bark beetles** (bottom left - Joseph Obrien, USDA Forest Service). All from Bugwood.org