

informing the public about DED and the need to control it; homeowners and ground-keepers informing those agencies of diseased trees or of the need for identification; and specialists removing and destroying infected trees and wood. Everyone must be aware of the problem so that elm wood is never stored on site or transported to other sites where it will be a hazard. In Manitoba and Saskatchewan the cutting of elm trees and transportation of elm wood are strictly controlled by law.

The help of the general public is critical to the control of DED. For more information on DED, including disease identification and removal, tree replacement, and legislation, one of the following sources should be contacted:

#### Manitoba

Manitoba Natural Resources (204) 945-7866  
Winnipeg residents only (204) 986-3456

#### Saskatchewan

Parks and Recreation (Regina) (306) 777-7900  
Saskatchewan Agriculture  
(Regina) (306) 787-4671  
Prairie Farm Rehabilitation  
Administration Tree  
Nursery (Indian Head) (306) 695-2284  
Parks and Recreation  
(Prince Albert) (306) 953-2221  
Saskatoon residents only (306) 975-2537

#### Alberta

Alberta Special Crops and  
Horticultural Research  
Centre (Brooks) (403) 362-3391

For the most recent information on chemicals available for the control of this disease, call Agriculture Canada's Pesticides Directorate in Ottawa (toll-free) at 1-800-267-6315.

Chemical pesticides are toxic to humans, animals, birds, fish, and beneficial insects. Follow all instructions and precautions listed by the manufacturer.

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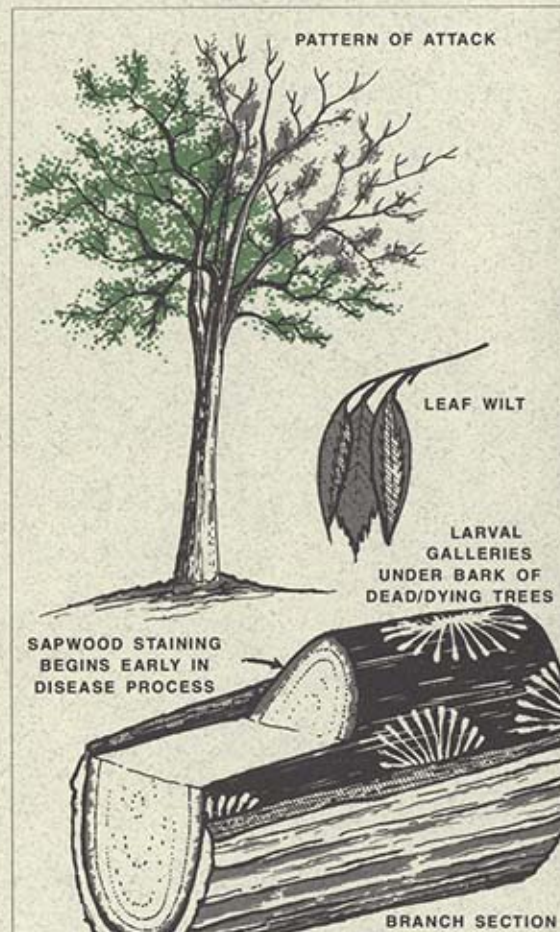


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Canada



## Dutch elm disease



Forestry Canada Forêts Canada



## Distribution and Hosts

Dutch elm disease (DED) is the most destructive disease of wild and planted elms in North America. It was first found in Ohio in 1930 and has since spread throughout almost the entire North American range of elms. In Manitoba the disease was found for the first time in 1975, and in Saskatchewan it appeared in 1981. As of December 1991 it had not been reported in Alberta. All native and introduced elms are susceptible to attack; however, a few species appear to be disease resistant.

## Symptoms and Damage

The first symptoms of DED usually appear in June and early July, when all of the leaves on a branch suddenly wilt. After about 10 days they turn brown and dry up. If a branch is infected in late summer, the leaves turn yellow, then wilt and fall off. When infection occurs in the fall the symptoms may be confused with natural foliage changes. Infection very late in the year may produce undersized leaves the following spring.

More than half of the 70 million landscape elms in the USA and millions of elms in eastern Canada have been killed by DED (real estate values have been affected by landscape damage). Young trees can be killed in a few weeks and larger, older trees in 1–2 years. Sometimes trees appear to recover, but, once infected, they almost always die. Very old, stressed, or weakened trees seem to be most vulnerable to DED and to the beetles that spread it.

## Casual Agent

Dutch elm disease is caused by a vascular wilt fungus (*Ophiostoma ulmi* [Buis.] Nannf.). It grows in the elm's xylem (wood that

carries water and nutrients from roots to leaves), producing toxins lethal to the tree and blocking water flow until the tree's transpiration is completely cut off. This fungus changes the sapwood color under the bark to a dark brown or black; the stain provides an early indication of infection, and is often easily identified in twigs and branches.

Other vascular wilt fungi produce symptoms very similar to those of DED, but seldom kill trees so quickly or become epidemic. Positive identification of DED and other wilt fungi should be made from cultures taken by local control authorities.

The disease is spread by two species of elm bark beetle (*Hylurgopinus rufipes* [Eichh.]; *Scolytus multistriatus* [Marsh.]). These beetles, 2–3 mm long, breed in stressed or recently killed trees, where the eggs they lay under the bark hatch into larvae (grubs). The larvae produce centipede-shaped galleries and feed on the fungus until they become adult beetles. Then they fly to nearby healthy trees to feed on bark in the crotches of small branches or wounds in the bark; the beetles usually travel less than 100 m, but they may travel up to 5 km to breed. The beetles carry sticky spores (fungus seeds) from infected trees into the sapwood of healthy trees. There, the fungus grows from the spores and spreads wherever the sap carries it—eventually killing the tree.

The beetles live under the bark of dead trees and logs that are still moist, as well as in dying trees. Therefore, trees killed by DED and left standing, fallen, or stacked up like firewood can be homes for beetles and fungus. Also, elm trees can graft their roots to the roots of other elms up to 13 m away, with the fungus being transferred through the sap.

## Prevention and Control

Prevention of DED is often indirect: through the removal of diseased and dead trees and the use of insecticides to kill the beetles. Professional removal of trees reduces the danger of spreading the disease and allows disease managers to monitor changing hazard levels. Another prevention strategy is to find or produce elms that are resistant to the disease: exotic elms, hybrid species, or particular strains of American elms (the most common species). Siberian, Japanese, Hanson Manchurian, and Urban (a cross between Netherlands and Siberian) elms have been found to be disease resistant.

Fall pruning is often recommended to homeowners; dead or injured branches that attract the beetles should be removed. Spring and summer pruning should be avoided because the trees are most susceptible to new infections during those months. In Manitoba it is illegal to prune elm trees between April 1 and July 31. Pruning equipment should be disinfected frequently to avoid spreading the spores. Fertilization, which is sometimes recommended, does not prevent DED; in fact, unnecessary fertilization may increase tree vulnerability by increasing the water-conducting tissue where the fungus grows.

Other control methods have been tried, with some success. Fungicide treatments by injection are expensive, and although they rarely, if ever, cure infected trees, they can help to prevent infection in very valuable elms. Sometimes the spread of DED through a root graft can be prevented by killing or cutting the roots between a healthy tree and a diseased tree.

The most effective control method, based on an integrated, community-centered approach, includes researchers looking for new control methods; government agencies