Extract from report: Invasive alien species in Switzerland. Factsheets, Federal Office for the Environment FOEN, Series: Environmental studies, p.114-115, 2006

Ceratocystis ulmi

Taxonomic status

Scientific name	Ceratocystis ulmi (Buisman) C. Moreau, Ceratocystis novo-ulmi (Brassier)
Synonyms	Ophiostoma ulmi (Buisman) Nanaf., Ophiostoma novo-ulmi
Taxonomic position	Fungi: Ascomycetes: Ophiostomatales
English name	Dutch elm disease
German name	Holländische Ulmenkrankheit
French name	Graphiose de l'orme
Italian name	Grafiosi dell'olmo

Description and identification

Description	Fruiting bodies are not produced in the field, but are easily obtained in the laboratory, through standard techniques. However, the identification of these fungi can be carried out by specialists only. Molecular markers are used as taxonomic tools. Symptoms on elm first appear in the crown of the tree. Leaves of infected trees will wilt, turn yellow, then curl and turn brown.
Similar species	Both genera names *Ceratocystis* and *Ophiostoma* are commonly used. *C. ulmi* and *C. novo-ulmi* are recognized as two different species, that can be separated morphologically and physiologically. The latter exists in two forms, EAN in Eurasia and NAN in North America, which subsequently invaded Europe (Hoegger et al., 1996).

Biology and Ecology

Life cycle	The life cycle of the disease is strongly associated with that of its vectors, scolytid beetles of the genus *Scolytus*. Beetles breed under the bark of diseased trees. New generations emerge from dead trees and carry fungal spores, infesting healthy elms on which they feed. Spores penetrate the tree and the fungus infects the xylem vessels, resulting in the mortality of branches or of the whole tree. The dead bark is suitable for egg deposition and larval development. In the meantime, the fungus produces new spores in the bark, which contaminate the newly emerging beetles.
Host plant	Nearly all European and American elm species (*Ulmus* spp.) are susceptible. In contrast, Asian species are more resistant.
Habitat	All habitats where elms are found.
Origin	Uncertain, probably Central Asia.

Introduction and dispersal

History of introduction	*C. ulmi* first appeared in Holland in 1919 and spread through Europe and to North America, where it caused enormous damage to American elms. In the 1960s, a new strain (subsequently recognized as a different species, *C. novo-ulmi*) appeared in both continents. This species had a tremendous impact on European elm species.
Pathways of introduction	Pathways of introduction include the transportation of infested plant material (e.g. logs) and bark beetles carrying the fungus.
Dispersal	On a local scale, the disease is dispersed by its insect vectors. It can be transmitted to adjacent trees by root grafts.

Current status

Actual and potential distribution in CH	Both species are now present throughout Switzerland. A discussion on the presence of the two species and their forms is provided in Hoegger et al. (1996).
Distribution in Europe	Both species occur throughout of Europe. The more virulent *C. novo-ulmi* has displaced *C. ulmi* in many countries (see, e.g., Kirisits et al., 2001).

Impacts

Damage on plant	The fungus kills trees by clogging the water vessels. Trees may die soon after infestation, but more usually one year later. Coppice shoots often regenerate from the root system.
Environmental impact	The ecological impact of the disease has been enormous, in both Europe and North America. Entire ecosystems have been modified. In many regions, elm species simply do not exist anymore as mature trees, although young trees resulting from coppice shoots are still common.
Economic impact	Elm species used to be very valuable multi-purpose indigenous trees, e.g. for timber, ornamentals, protection, hedges, fodder, medicine, etc. Because of Dutch elm disease, elms are no longer used.
Management options	Management options are limited (Röhrig, 1996). Silvicultural practices include the removal and burning or burying of infested trees, or winter pruning. Systemic fungicides are sometimes used as a preventive method to protect high-value trees. Breeding elm for resistance is probably the most promising option. Chemical or biological control methods targeting bark beetles have been implemented, with little success.
Information gaps	

References

Literature

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