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Data Sheets on Quarantine Pests

Hypoxylon mammatum

IDENTITY

Name: *Hypoxylon mammatum* (Wahlenberg) J. Miller
Synonyms: *Hypoxylon pruinatum* (Klotzsch) Cooke
Taxonomic position: Fungi: Ascomycetes: Xylariales
Common names: Hypoxylon canker (English)
Chancre du tremble (French)
Rindenbrand (German)
Notes on taxonomy and nomenclature: At one time, *H. pruinatum*, the name mostly then used for the harmful pathogen in North America, was considered to be a species distinct from *H. mammatum*. They are now accepted to be synonyms, and the name *H. mammatum* has priority (Miller, 1961).
Bayer computer code: HYPOMA
EPPO A2 list: No. 72 (deleted in 1984)
EU Annex designation: II/B

HOSTS

The principal hosts are, in Europe, the native species *Populus tremula* (especially its mountain race) and, in North America, *P. tremuloides*, which has also been introduced into Europe, as such and in hybrid form. *P. grandidentata* is less affected. Species of section *Leuce* of the genus *Populus* are essentially those affected (Pinon, 1986). The fungus has also been reported on a few other woody genera, but this probably reflects the broader concept of the species by which it includes both saprobic and pathogenic forms (Manion & Griffin, 1986). Inoculation tests on clones of *Populus deltoides*, *P. canadensis* and *P. trichocarpa* widely cultivated in Europe have shown them to be resistant. Thus, the main species at risk in Europe is the commercially exploited *P. tremuloides* (*P. tremula* mainly grows as a wild species, especially in mountain areas).

GEOGRAPHICAL DISTRIBUTION

Though at one time it was thought that *H. mammatum* was introduced into Europe from North America, it is now considered more probable that it occurs naturally throughout the temperate zone of the Northern Hemisphere (Bier, 1940; Pinon, 1979).
EPPO region: Andorra, Czech Republic, Finland (unconfirmed), France, Germany, Italy, Russia (European, Siberia), Sweden, Switzerland, UK (England, Channel Islands), Ukraine, Yugoslavia.
North America: Canada (British Columbia to Nova Scotia, especially in Alberta and Quebec), USA (especially Michigan, Minnesota, Wisconsin; also in Alaska, Iowa, Montana, New Hampshire, New York).
EU: Present.
Distribution map: See CMI (1987, No. 465).

BIOLOGY

H. mammatum overwinters as mycelium in the host tissues (generally not deeper than 8 mm in the wood), or as spores. Two types of spores are produced: (a) ascospores, liberated at high relative humidity and low temperature, are first produced 3 years after infection; (b) conidia are produced within 5-14 months of infection, but are not thought to be of any significance in disease transmission.

The infection process remains to be elucidated, but it is thought that wind-borne ascospores enter through wounds in the periderm, and are also able to invade tissues beneath sound bark. In the USA, a high proportion of cankers have been found to originate in insect wounds, notably galls caused by the cerambycid beetle *Saperda inornata*, or cicada oviposition wounds (Ostry & Anderson, 1983). The fungus is not thought to infect via buds, leaves, petioles or leaf axils.

Studies in France (Anderson, 1964) showed that trees of all ages were attacked, but disease incidence was often low. Growth of the fungus occurred only between 8 and 32°C, the optimum temperature being 28°C. Host-specific toxins are involved in pathogenesis (Stermer *et al.*, 1984).

For more information, see Bier (1940), Gruenhagen (1945), Berbee & Rogers (1964), Hubbes (1964), Anderson *et al.* (1979).

DETECTION AND IDENTIFICATION

Symptoms

Trees between 15 and 40 years old suffer most severe damage. Symptoms first appear on the bark as slightly sunken, yellowish-orange areas with an irregular margin. Later, the outer bark becomes raised in blister-like patches and sloughs off to expose the blackened crumbling cortex; these blackened areas stand out on the green trunks. All cell types, except sclerenchyma, are destroyed. Old cankers may be up to 2.5 m in length. In general, callus formation is limited as canker spread is so rapid. The foliage may show a withering and, once the trees are girdled by the canker, they die. Trees may also break at the canker level and put up a new shoot. As the trees are weakened, secondary fungi may invade and speed up the killing process. For more information, see Bier (1940), Anderson (1956).

Morphology

Cutting into the diseased yellowish bark of young cankers, or near the margin of old ones, will reveal a laminated or mottled, black and yellowish-white cortex. This distinguishes from bark yellowing due to other fungi (*Valsa* spp.). White mycelial fans occur in the cambial zone at the margin of the cankers, and can be seen when the bark is removed. Characteristic "conidial pillars" form below the periderm.

Conidia are produced in grey, powdery masses under the blistered bark; one-celled, oblong-ovoid, hyaline, 4-7 x 1-2 µm. Perithecia are formed about 3 years after conidia in erumpent, flattened, hard, black stromata which have a thin, white, pruinose surface layer when young and are up to a few millimetres across. Ascospores are brown, oblong-ellipsoid, one-celled, 22-30 x 8-13 µm.

For more information, see Hawksworth (1972), Pinon (1975).

Detection and inspection methods

Detection of latent infections is a lengthy process (Anderson & French, 1973). The top ends of stem sections should be dipped in paraffin and the sections incubated in moist sand at 24°C and 90% RH for 3 months, and observed for fungal development.

MEANS OF MOVEMENT AND DISPERSAL

H. mammatum is naturally dispersed within plantations by ascospores. In international trade, young plants may carry ascospores or mycelium of the fungus, and so may wood, particularly with the bark remaining; it should be noted that the fungus can exist as a latent infection (Anderson & French, 1973).

PEST SIGNIFICANCE

Economic impact

This is one of the most serious diseases of *P. tremuloides* in North America, affecting trees of all ages and up to 77% of some *Populus* stands. For the Lakes States region in the USA alone, it has been estimated that the disease caused an annual growth impact loss of 3.36 m^3 - equivalent to about 31% of the net growth on the 7380 400 ha of *P. tremuloides* in the region. Future losses will probably be similar. Well-stocked, mixed stands are less susceptible to infection. For more information, see Anderson (1964), Forbes *et al.* (1967), Davidson & Prentice (1968), Falk *et al.* (1989). In a general review, Manion & Griffin (1986) recognized the importance of the disease in North America and the research attention paid to it; they noted, however, that other diseases perhaps deserve as much attention.

In the EPPO region, *H. mammatum* has been recorded as occurring mainly on the mountain race of *P. tremula* in France. This host can be quite severely damaged, but it has no direct economic importance and can recover easily by suckering (Pinon, 1986). *P. alba* appears not to be infected. The hybrid grey *Populus* between the indigenous species *P. alba* and *P. tremula* are also little affected and can be grown without risk. However, *P. tremula* x *P. tremuloides* hybrids have been found susceptible in Lorraine, and care should be taken to plant only fairly resistant hybrids. It would also be prudent to check the susceptibility of new *P. alba* and *P. tremula* hybrids, since there are some indications that they might be more susceptible than their parents. The risk presented by *H. mammatum* in Europe thus depends on the susceptibility of the clones which are planted. Since *H. mammatum* has been more fully documented in France, it has become apparent that it is also present in similar situations in many other EPPO countries (Pinon, 1986). In general, *H. mammatum* is not currently reported to be of significant economic importance in any of these countries.

Control

There are no satisfactory control measures, although, in North America, resistance breeding (for the production of wound callus tissues) has had some success. It is actively continuing, and tissue culture screening methods are being used. Inhibition of the fungus can be obtained by spraying with saprophytic fungi. Elimination of trees as soon as they become infected, before ascospore production, should minimize spread of the disease.

Phytosanitary risk

EPPO did at one time list *H. mammatum* as an A2 quarantine pest (OEPP/EPPO, 1983), but decided to delete it from the list in 1984. This decision was based on the fact that the fungus is now known to be much more widely distributed in the EPPO region than was previously thought, that on native species it seems to have reached the limits of its potential distribution, and that on hybrid *Populus*, while it does present some danger, it is a commonplace indigenous pathogen and not a quarantine pest. If there is a potential *H. mammatum* problem in the EPPO region, its solution lies in ensuring that new *Populus* hybrid selections of sections *Leuce* and *Tacamahaca* carry adequate resistance (Pinon, 1986).

PHYTOSANITARY MEASURES

Populus wood from countries where the disease occurs should be inspected for the presence of cankers, and should preferably be barked.

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