Prepared by CABI and EPPO for the EU under Contract 90/399003

Data Sheets on Quarantine Pests

Cronartium quercuum

IDENTITY

Name: *Cronartium quercuum* (Berkeley) Miyabe ex Shirai
Anamorph: *Peridermium cerebrum* Hedgcock & Long
Taxonomic position: Fungi: Basidiomycetes: Uredinales
Common names: Eastern pine gall rust (English)
Notes on taxonomy and nomenclature: The uredinial rust *Uredo quercus* is widely distributed but rather uncommon on *Quercus* throughout Europe and especially in Mediterranean countries. Viennot-Bourgin (1956) mentions that the telial state has once been found in France, and identifies it as *C. quercuum*, but with little supporting detail. No corresponding aecial state has ever been found in Europe and, on this basis, "*C. quercuum*" would exist in Europe only as a short-cycle uredinial rust (although it is not reported to behave in this way in North America). The basis for this identification of the two fungi does not seem sufficiently critical for plant quarantine purposes. See also remarks under Pest significance.

The recent North American literature refers to *C. fusiforme* (EPPO/CABI, 1996) as a *forma specialis* of *C. quercuum*, and distinguishes several other *formae speciales* (see Biology) on different *Pinus* spp. In addition, the Asiatic forms of *C. quercuum* have been described as another *forma specialis*. The same may apply in Central America, where yet other *Pinus* spp. are hosts.
Bayer computer code: CRONQU
EPPO A1 list: No. 252
EU Annex designation: I/A1 - as *Cronartium* spp. (non-European)

HOSTS

The aecial hosts of *C. quercuum* in Asia are mainly *Pinus densiflora* and *P. thunbergii*, in China and Japan, and also *P. kesiya* (in the Philippines), *P. luchuensis* (in Japan), *P. takahasii*, *P. massoniana* and *P. tabulaeformis* (in China). The aecial hosts of *C. quercuum* in North America are two- and three-needled *Pinus* spp., of which the most important in practice are jack pine (*P. banksiana*), across central and eastern Canada, shortleaf pine (*P. echinata*) and Virginia pine (*P. virginiana*) in north-central and eastern USA. The European Scots pine (*P. sylvestris*), widely planted in North America, is susceptible. Other *Pinus* spp. are attacked to a limited extent in different parts of North America: western yellow pine (*P. ponderosa*) planted in eastern USA, Table Mountain pine (*P. pungens*), red pine (*P. resinosa*) and pitch pine (*P. rigida*) in eastern USA, sand pine (*P. clausa*) and spruce pine (*P. glabra*) in southeastern USA. Records on slash pine (*P. elliottii*) and loblolly pine (*P. taeda*) probably refer to *C. fusiforme*. In Mexico, other species are recorded as hosts (*P. leiophylla* var. *chihuahuana*, *P. montezumae*). The European species Austrian pine (*P. nigra*) has been found to be susceptible in North America. The main potential host in the EPPO region would appear to be *P. sylvestris*, and possibly also *P. nigra*.

The telial hosts in North America are mainly *Quercus* spp., of the red oak group and generally not the white oak group. A typical host species is the northern red oak (*Q. rubra*). The situation is complicated by the fact that *C. quercuum* can hardly be distinguished from *C. fusiforme* on the telial host, and that many records probably refer to the latter which is much more important in practice. North American *Castanea* spp. such as *C. dentata* and *C. pumila* have also been recorded as hosts. The situation concerning telial hosts in Central America is not clear. In Asia, *Q. serrata* is mentioned as a telial host, and also the fagaceous genera *Castanopsis* and *Cyclobalanopsis*. American *Castanopsis* spp. do not overlap in range with *C. quercuum.* For more information, see Spaulding (1956, 1961), Boyce (1961), USDA (1963), Davidson & Prentice (1967), Peterson (1967), Hepting (1971), Ziller (1974).

GEOGRAPHICAL DISTRIBUTION

In North America, *C. quercuum* mainly occurs over a range from the Great Lakes area southeastwards, in the areas of mainly deciduous forest where the woody telial hosts are abundant. This is generally further south than the range of the "blister rusts" (e.g. *C. coleosporioides*; EPPO/CABI, 1996) which are typical of coniferous forests.
EPPO region: Absent (the claim that the uredinial state *Uredo quercus*, occurring in Europe, is in fact *C. quercuum* seems inadequately substantiated (see note under Identity).
Asia: China (Anhui, Gansu, Guangxi, Guizhou, Heilongjiang, Henan, Hubei, Hunan, Jiangsu, Jiangxi, Sichuan, Shaanxi, Yunnan, Zhejiang), India (unconfirmed), Japan, Korea Democratic People's Republic, Korea Republic, Philippines, Taiwan (unconfirmed).
North America: Canada (Alberta, Manitoba, New Brunswick, Nova Scotia, Ontario, Quebec, Saskatchewan), Mexico, USA (Lake states - Michigan, Minnesota, Wisconsin - and eastern states; a record on *P. ponderosa* in California is probably not this species).
Central America and Caribbean: Belize, Costa Rica, Cuba, El Salvador, Honduras, Nicaragua, Panama.
South America: Guyana.
EU: Absent.

BIOLOGY

Most of the information of the biology of *C. quercuum* comes from North America, and relatively little seems to be known about the species in Asia. Broadly, its biology is like that of the other heteroecious North American *Cronartium* spp., and the following general account can be applied. Pycnia and aecia are produced on the *Pinus* hosts in the spring and early summer, one to several years after infection. In *C. quercuum*, unlike the other species, aecia usually appear in the year after the formation of pycnia and not in the same year. Aeciospores can be carried over long distances in the wind and infect the alternate (telial) host; they cannot reinfect *Pinus*. Within 1-3 weeks after infection, uredinia appear on the alternate hosts, and telia develop about 15 days later (earlier in *C. quercuum* than in other species). *Pinus* become infected via the first-year needles by the wind-borne basidiospores which arise from germination of teliospores; the telial host cannot be reinfected by basidiospores. Basidiospore infection, which occurs in summer and autumn, is usually limited to an area within 1.5 km of the alternate host, owing to the spores being delicate and short-lived. Infection of *Pinus* by basidiospores completes the life cycle.

Host-specific *formae speciales* have been defined (Burdsall & Snow, 1977) within *C. quercuum*: f.sp. *banksianae* on *P. banksiana*, f.sp. *echinatae* on *P. echinata*, f.sp. *virginianae* on *P. virginiana* (and, in the American usage, f.sp. *fusiforme*, on *P. elliottii* and *P. taeda*). In Japan, the form on *P. densiflora* has been named f.sp. *densiflorae* (Kuhlman

& Kaneko, 1991). For more information, see also Boyce (1961), USDA (1963), Davidson & Prentice (1967), Peterson & Jewell (1968), Peterson (1973), Ziller (1974).

DETECTION AND IDENTIFICATION

Symptoms

Initially, a slight hemispherical swelling on one side of the stem appears; this enlarges, becomes spherical and finally elongates. Such elongated galls with collars occur typically on branches of older *Pinus* but cause little damage. Infection of seedlings, however, results in severe stunting or rapid death. Galls on the trunk of *P. virginiana*, if partially grown over, result in lesions that resemble "hip canker" caused by *E. harknessii*. Within the gall, hyphae occur mainly in the rays, being abundant in the bark and sparse in the wood. In the spring, aecia break through the bark of galls in a more or less cerebroid arrangement.

Morphology

Spermatia hyaline, oblong-elliptic; 2 x 4 µm. Aecia with thick cerebroid peridia. Aeciospores yellow-orange, obovoid or ellipsoid, wall coarsely verrucose and flattened on one side; 15-18 x 24-29 µm. Urediniospores yellow, ovoid-ellipsoid, with echinulate walls; 11-15 x 18-24 µm. Telial columns chestnut-brown. Basidiospores hyaline, ellipsoid; 4 x 6 µm. The fungus has been cultured (Yamazaki & Katsuya, 1987).

Detection and inspection methods

Isoenzyme and protein analysis of aeciospores can differentiate between *Endocronartium harknessii* and *C. quercuum*, and between the *formae speciales* of *C. quercuum* (Powers *et al.*, 1989).

MEANS OF MOVEMENT AND DISPERSAL

Cronartium spp. can be carried considerable distances as wind-borne aeciospores and can survive considerable periods in the airborne state (Chang & Blenis, 1989). More importantly, these rusts can also be carried into new areas on plants for planting of the coniferous aecial hosts, as has occurred in parts of the USA. The long incubation periods of *Cronartium* rusts mean that latent infections easily go undetected unless post-entry quarantine is applied. The alternate hosts of *C. quercuum* are wild woody plants, many of which are unlikely to be traded internationally; however, some *Castanea* and *Quercus* spp. could enter trade. In this case, because they are deciduous and infection is restricted to the leaves, there should be no risk in shipment of dormant material. Similarly, there is no risk in movement of *Pinus* seeds or pollen.

PEST SIGNIFICANCE

Economic impact

The *Cronartium* rusts cause very important diseases throughout the world, resulting in malformation, reduced vigour and death of trees and seedlings of the aecial hosts. However, their abundance does depend primarily on the abundance of the alternate host (Gross *et al.*, 1983). *C. quercuum* is damaging in nurseries and young plantations of *Pinus* in North America, where it has been recorded to cause 25% losses on *P. sylvestris*. In general, however, it attracts much less attention in the North American literature than the closely related *C. fusiforme*, or *Endocronartium harknessii*. Shao *et al.* (1989) record *C. quercuum* as damaging on *P. takahasii* in northern China, but it is not clear whether the species has much practical importance in Japan. There is no particular indication of economic importance in Central America. *C. quercuum* is of no direct practical importance

on its telial hosts. For more information on the pest significance of *Cronartium* spp., see also Boyce (1961), Peterson & Jewell (1968), Ziller (1974), Sinclair *et al.* (1987).

Control

Control can be effected by removing infected material. Eradicating the alternate host is not a practical possibility for *C. quercuum*, though nurseries should if possible be located away from infection sources. The use of chemical spraying is feasible. Research into resistant forms may lead to successful control of *C. quercuum* (Burnes *et al*., 1989).

Phytosanitary risk

C. quercuum is one of the non-European *Cronartium* spp. of the EPPO A1 list (OEPP/EPPO, 1979). The danger presented by these fungi to the EPPO region is classically exemplified by reference to the quarantine pest *C. ribicola* (Phillips, 1988), which has made it almost impossible to grow *P. strobus* commercially in most areas in Europe and North America to which the fungus was introduced from Asia. However, it should be stressed that the potential risk from introduced *Cronartium* spp. is much affected by the status of the alternate hosts concerned. The telial hosts of *C. quercuum* are, in North America, mainly *Castanea* and *Quercus* spp. indigenous to that continent. No information seems to be available on the susceptibility of European species of these genera. The most widespread European oaks are "white oaks" (subgenus *Quercus*), and thus belong to the group which is not susceptible in North America. North American red oaks are planted to a limited extent in Europe (e.g. especially *Q. rubra*). The European evergreen oaks could be susceptible, but there is no direct evidence of this. The Asian telial host *Q. serrata* is a rarely cultivated garden ornamental in Europe. It is not clear how many other Asian species may be telial hosts, but in general Asian oaks are little grown in Europe. Thus, in favour of the importance of *C. quercuum* as a quarantine pest for the EPPO region is the fact that the most important European pine (*P. sylvestris*) has suffered serious losses from this rust at the nursery stage in North America. On the other hand, the other significant *Pinus* hosts of *C. quercuum* (in North America or Asia) have no importance in Europe, and no European species has been specifically recorded as a telial host. Successful establishment of *C. quercuum* in Europe would thus depend on the conjectural susceptibility of some European *Castanea* or *Quercus* species. Accordingly, *C. quercuum* can be considered to present only a moderate risk for the EPPO region.

PHYTOSANITARY MEASURES

Since symptoms may not be apparent for many years after infection, the only practical safeguard is to prohibit entry of the *Pinus* hosts from countries where *C. quercuum* occurs. *Castanea* and *Quercus* spp. should only be imported in a dormant state, without leaves. Bark and wood of *Pinus* should have been appropriately treated (heat-treated, fermented, kiln-dried; EPPO quarantine procedures are in preparation).

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