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Data Sheets on Quarantine Pests

Botryosphaeria berengeriana f.sp. *piricola*

IDENTITY

Name: *Botryosphaeria berengeriana* de Notaris f.sp. *piricola* (Nose) Koganezawa & Sakuma
Synonyms: *Physalospora piricola* Nose *Guignardia piricola* (Nose) Yamamoto
Anamorph: *Fusicoccum* sp.*Macrophoma kuwatsukai* Hara and *M. pirorum* Cooke have also been referred to as anamorphs of *B. berengeriana* in east Asia.
Taxonomic position: Fungi: Ascomycetes: Dothideales
Common names: Physalospora canker, wart bark, blister canker, apple ring rot (English)
Rinmonbyo, ibokawabyo (Japanese)
Notes on taxonomy and nomenclature: The pathogen has long been known as *Physalospora piricola* in Japan, while the name *Guignardia piricola* (used in the EU Plant Health Directive) was proposed by Yamamoto (1961) for the same pathogen, but not accepted. Koganezawa & Sakuma (1980; 1984) compared the pathogen with another fungus causing fruit rot in Japan, which they call *Botryosphaeria berengeriana*, and concluded that the two fungi are identical morphologically. *B. berengeriana* is usually considered to be a synonym of *B. dothidea* (Mougeot: E.M. Fries) Cesati & de Notaris, a fungus which is widespread in warm temperate regions. However, the Japanese authors regard it as a synonym of *B. ribis* Grossenbacher & Duggar, which they and some others consider to be distinct from *B. dothidea* and which is also widespread in temperate regions. Other authors consider *B. dothidea* and *B. ribis* to be synonymous (Brown & Britton, 1986). *B. dothidea* causes white rot of pome fruit, while yet another species, *B. obtusa* (Schweinitz) Shoemaker, causes black rot (Jones & Aldwinkle, 1990).

Because the Japanese isolates of *B. berengeriana*, previously known as *P. piricola*, cause distinctly different symptoms (wart bark) from the cankers due to typical *B. berengeriana*, Koganezawa & Sakuma (1984) proposed the name *B. berengeriana* f.sp. *piricola* for the fungus causing apple wart bark and *B. berengeriana* f.sp. *persicae* for a similar fungus causing blister canker of peaches. These names have not been used outside Japan. Elsewhere in Asia, the agent of apple ring rot is simply called *B. dothidea* (Kim & Kim, 1989), or sometimes *B. berengeriana* (Lee & Yang, 1984), or sometimes still *P. piricola*. *B. berengeriana* has also been recorded on apples in Brazil (Melzer & Berton, 1986), but the name is more probably being used in this case as a simple synonym of *B. dothidea*. Jones & Aldwinkle (1990) regard *B. berengeriana* f.sp. *piricola* as a synonym of *B. dothidea*. It may also be noted that it is not usual to name as a *forma specialis* a fungus which attacks species in more than one host genus (see Hosts).
Bayer computer code: PHYOPI
EU Annex designation: II/A1 - as *Guignardia piricola*

HOSTS

The main host is Japanese pears (*Pyrus pyrifolia*), but European pears (*P. communis*) and apples are also attacked. Other hosts mentioned by Kato (1973) are *Chaenomeles japonica*

and *Malus micromalus*. *B. dothidea* in the broad sense, including *B. ribis*, occurs on a wide range of woody hosts (Punithalingam & Holliday, 1973; Farr *et al.*, 1989).

GEOGRAPHICAL DISTRIBUTION

B. dothidea in the broad sense occurs very widely, while the agent of apple ring rot (under various names) has been recorded only from eastern Asia and has not apparently spread from there. The name *B. berengeriana* has also been used for an apple pathogen in Brazil, but presumably refers simply to *B. dothidea*.

EPPO region: Absent.

Asia: China (Anhui, Fujian, Guangxi, Hubei, Hebei, Henan, Hunan, Jilin, Jiangsu, Jiangxi, Liaoning, Sichuan, Shandong, Shanxi, Zhejiang; Dong & Zhou, 1985), Japan (Honshu and Shikoku especially), Korea Democratic People's Republic, Korea Republic, Taiwan (Hsu, 1989).

EU: Absent.

BIOLOGY

B. berengeriana f.sp. *piricola* infects the branches, shoots, leaves and fruits of its hosts. Pycnidia form on diseased branches and shoots after these have withered, during the period from April to September, but mainly in August and September. Sporulation is most abundant on infected shoots of 2-3 years old and less on older wood. The pycnidiospores are rain-dispersed, usually up to about 10 m, but exceptionally up to 20<NBS>m by strong wind-driven rain. They mostly germinate within the first 24 h, and infection is favoured by warm humid conditions (optimum temperature 28°C). Infection of young fruits requires 5 h of surface wetness, while older fruits need longer.

Under experimental conditions, artificial wounding is needed for branches to be infected, although shoot tips and young leaves can be infected without wounding. Natural infection of shoots probably occurs through the shoot tip. Similarly, young fruits can be infected early in the season (up to mid-July) through stomata or lenticels (Kishi & Abiko, 1971). Thereafter, wounds are needed for infection of fruits (e.g. punctures of *Grapholita molesta*; EPPO/CABI, 1996).

The incubation period for infection of shoots is 90-120 days, so that shoots infected during April-August show symptoms in September-November, and provide inoculum in the following year. Leaves are infected in July-August, with an incubation period of about 30 days. The occurrence of the disease on fruits can be predicted from the number of rainy days in May by a quadratic regression equation (Kato, 1973).

Ascomata are found on withered branches, but ascospores are not reported to play a significant role in disease spread.

This description of the biology of *B. berengeriana* f.sp. *piricola* is taken from the Japanese literature; it is, however, very broadly similar to that of *B. dothidea*, for example in south-eastern USA (McGlohon, 1982; Brown & Britton, 1986; Jones & Aldwinkle, 1990), or in Korea (Kim & Kim, 1989).

DETECTION AND IDENTIFICATION

Symptoms

On Japanese pears (Kato, 1973), the fungus forms wart-like protuberances (wart bark) on the surface of trunks and branches, rather than typical *Botryosphaeria* cankers. These are subsequently surrounded by dark-brown spots. Infected twigs eventually wither and die back. Large contoured dark-brown spots are formed on the leaves and also on the fruits. The warts on trunks and branches damage the tree, reducing its growth and productivity.

The leaf spots are of minor importance and do not affectyield. The fruit spots progress after harvest, and thus cause a loss of fruit quality.

On apples, the fungus causes similar symptoms of rough bark (Koganezawa & Sakuma, 1980) and apple ring rot (Koganezawa & Sakuma, 1984).

Morphology

According to Koganezawa & Sakuma (1984), the morphology of the fungus is identical to that of *B. dothidea*. The fungus is rather variable in the size of the stroma, asci and ascospores. Asci are 80-130 x 14-23 µm, and ascospores 19-26 µm. The conidia, formed in pycnidia of *Fusicoccum* type, are 23-29 x 6-8 µm.

In the dark, colonies of all isolates on PDA are initially white, turning grey and then black. In diffuse light (Koganezawa & Sakuma, 1984), isolates of f.sp. *piricola* remain grey, while isolates of *B. dothidea* from various hosts (including *Malus* and *Pyrus*) turn yellowish-brown.

The morphology of *B. ribis* has been described by Punithalingam & Holliday (1973), and the figure from that description has been used by Jones & Aldwinkle (1990) in their description of *B. dothidea*.

MEANS OF MOVEMENT AND DISPERSAL

B. berengeriana f.sp. *piricola* is locally dispersed by rain. In international trade, it is most likely to be carried as latent infections on young shoots of planting material. Although fruits are infected, infection occurs on the young fruit, and would be detectable on harvested fruits, rather than only appearing later in storage (post-harvest rot). Accordingly, infected fruits are relatively unlikely to be traded.

PEST SIGNIFICANCE

Economic impact

As *Physalospora piricola*, the fungus was listed as one of the economically important pests of apples and pears in Japan (Anon., 1984), being responsible for branch dieback (of the mal secco type) and fruit rot. According to Koganezawa & Sakuma (1984), it has become more important, causing apple fruit rot in the 1980s, since Bordeaux mixture has been less frequently used in orchards and the practice of bagging fruits has declined (in Japan, high quality pome fruits are often individually bagged on the tree to protect them from all kinds of damage). Presumably, the disease was previously well controlled by copper fungicides.

B. dothidea, in the wide sense, also causes a branch canker of pome fruit trees, and white rot of fruits. It is not regarded as very important over most of its range, but has recently become much more severe in the south-eastern USA (McGlohon, 1982; Brown & Britton, 1986; Jones & Aldwinkle, 1990).

Control

Copper fungicides have proved effective in Japan, and the reduction in their use has led to a resurgence of apple fruit rot. Captafol, benomyl, captan, difolatan, polyoxin and 8-hydroxyquinoline are other fungicides which have been shown to be effective (Kishi & Abiko, 1971; Kato, 1973). Organic arsenic emulsion has been recommended in Japan for treatment of the warts on the shoots, though it is doubtful whether such products would now be authorized for this use. Sato *et al.* (1987) have recently investigated eradicant fungicides for trunk lesions.

In general, it is recommended to take measures to reduce the pycnidiospore inoculum. Branches showing symptoms of infection should be pruned. The warts on shoots can be

shaved away. Affected fruits should be removed and destroyed. Some cultivars are reported to have resistance (Cho *et al.*, 1986).

Similar fungicides are recommended against *B. dothidea* in the USA (McGlohon, 1982) and Korea (Kim & Kim, 1989).

Phytosanitary risk

Neither EPPO nor any other regional plant protection organization has considered *B. berengeriana* f.sp. *piricola* to be a quarantine pest. In Japan, the fungus is certainly claimed to be more important than *B. dothidea* and to cause different symptoms. Though mainly occurring on Japanese pears, the fungus has been recorded in Japan damaging European pears and apples. It is not clear, however, whether the fungus can really be distinguished from *B. dothidea*, and how feasible it is to take measures against f.sp. *piricola* alone. In addition, it may be noted that the Japanese fungus, like *B. dothidea* in south-eastern USA, is favoured by rather warmer, more humid conditions than prevail in Europe or the Mediterranean region.

PHYTOSANITARY MEASURES

If phytosanitary measures against *B. berengeriana* f.sp. *piricola* are justified, then prohibition of the import of plants for planting of *Malus* and *Pyrus* spp. from infested countries would be appropriate, in view of the presumed difficulty of ensuring that they are free from latent infection.

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