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Data Sheets on Quarantine Pests

Monilinia fructicola

IDENTITY

Name: *Monilinia fructicola* (Winter) Honey
Synonyms: *Sclerotinia fructicola* (Winter) Rehm
Anamorph: *Monilia* sp.
Taxonomic position: Fungi: Ascomycetes: Helotiales
Common names: Brown rot, twig canker (English) Pourriture brune (French)
Fruchtfäule des Kern- und Steinobstes (German)
Rot pardo de los frutales (Spanish)
Bayer computer code: MONIFC
EPPO A1 list: No. 153
EU Annex designation: I/A1

HOSTS

The main host range of this fungus covers the rosaceous fruit trees: principally peaches and other *Prunus* spp., to a lesser extent apples and pears; the fungus can also be found on *Chaenomeles*, *Crataegus*, *Cydonia* and *Eriobotrya*. A recent report from Japan (Visarathanonth *et al.*, 1988) claims that *M. fructicola* also causes a brown rot of grapes. Infected grapes were found in a wholesale market in Tokyo and inoculation tests were successful.

In the EPPO region, apples, pears and peaches are the most widely cultivated hosts.

GEOGRAPHICAL DISTRIBUTION

EPPO region: Egypt (unconfirmed).
Asia: India (Himachal Pradesh), Japan (Honshu), Taiwan, Yemen.
Africa: Egypt (unconfirmed), South Africa, Zimbabwe (IAPSC, 1985).
North America: Canada (Ontario), Mexico, USA (widespread).
Central America and Caribbean: Guatemala, Panama; probably widespread.
South America: Argentina, Bolivia, Brazil (Rio Grande do Sul, São Paulo), Ecuador, Paraguay, Peru, Uruguay, Venezuela; reported absent from Chile.
Oceania: Australia (New South Wales, Queensland, South Australia, Tasmania, Victoria, Western Australia), New Zealand.
EU: Absent.
Distribution map: See IAPSC (1985, No. 306), CMI (1991, No. 50).

BIOLOGY

M. fructicola overwinters in or on mummified fruit, or in infected tissues on trees, such as twigs, peduncles and cankers on branches. Conidia produced on these under humid conditions in spring are wind-dispersed and, in the presence of moisture, will infect blossoms, causing blossom blight. This generally leads to infection of the young twigs or leaves (twig and leaf blight) and stem cankers.

Moisture plays an important role in the infection pathway of the fungus. Without a wetting period, infection is nearly nil even in the presence of large inocula; with only a 3-h wetting period infection remains very low (Wilcox, 1989); with wetness periods of 15 h, over 80% of cherries are infected by the pathogen (Biggs & Northover, 1988).

Further conidia are produced which infect ripening fruits. Conidial production itself is influenced by temperature. Temperatures around 15°C favour the development of bigger conidia, with a greater nuclear number, better germination and, most important, increased aggressiveness (Phillips, 1984; Phillips *et al.*, 1989). Infected fruits normally mummify, but if infection occurs at or near harvest, post-harvest rot may develop.

The teleomorph, rarely seen in the related European species *M. fructigena* and *M. laxa*, is significant in the life cycle of *M. fructicola*. Apothecia are erratically formed on fallen mummified fruits in spring. They release ascospores in damp weather which, in the presence of free moisture, will infect blossoms.

DETECTION AND IDENTIFICATION

Symptoms

M. fructicola cannot in principle be distinguished from the other brown rot fungi except by laboratory examination (see below). It tends to occur more often on peaches and nectarines, while *M. laxa* favours apricots and almonds. However, both species can occur on all *Prunus* spp. and are difficult to differentiate (Wilson & Ogawa, 1979). *M. fructigena* is more characteristically found on apples and pears. On fruit, a soft brown rot (sometimes turning black in apple) is followed by the appearance of conidial pustules on the surface of the fruit (especially on cut surfaces). These are grey-coloured in *M. fructicola* and *M. laxa*, but distinctly buff-coloured when freshly formed in *M. fructigena*. In low humidity, pustules may not develop; instead, the whole fruit shrivels into a wrinkled mummy. Infected blossoms and leaves turn brown and wither, producing a typical blighted appearance. Stem infections lead to brown, collapsed areas (cankers), often with an accumulation of surface gum. Tufts of conidiophores appear on these infected tissues under humid conditions.

Morphology

Table 1 summarizes the main differences between *M. fructicola* and the two related European species.

Conidial dimensions are more variable in nature, depending on temperature (longer at 15 than at 25°C) and host species (Phillips, 1984). On oatmeal agar (Sonoda, 1982), distinct (occasionally black) lines form between colonies of *M. fructicola* and *M. laxa*.

The electrophoretic and isoelectric focussing patterns of several enzymes clearly distinguish *M. fructicola* from *M. laxa* (Penrose *et al.*, 1976; Byrde & Willetts, 1977; Willetts *et al.*, 1977; Mordue, 1979).

Table 1. Main differences between *Monilinia fructicola* and the two related European species in culture.

Species	Conidial dimensions in culture	Hyphal diameter	Germ tubes *
M. fructicola	14.5-16 x 9.5-11 µm	Relatively narrow	Long, branching (if at all) far from spore
M. fructigena	18-21 x 11.5-13 µm	Relatively wide	As above
M. laxa	11.5-17 x 8-11 µm	Relatively narrow	Short, branching near spore
	Sporulation**		Colony shape**
M. fructicola	Abundant with stromata and spermatia		Margin entire
M. fructigena	As *M. fructicola* but much less abundant		Margin entire
M. laxa	Virtually none		Lobed margin

* After 12 h in nutrient medium
** After 3 days on malt agar in the light

MEANS OF MOVEMENT AND DISPERSAL

The risk of international spread by natural means is relatively low, even if the fungus can be dispersed by wind and by insects, such as *Drosophila melanogaster* (Diptera) which can be contaminated by the fungus (Michailides & Spotts, 1990). The most likely means of entry is on planting material of susceptible genera, especially rooted plants but to a lesser extent budwood. There is also a certain risk from fresh fruit, especially apples, pears and fruit of *Prunus* spp.

PEST SIGNIFICANCE

Economic impact

M. fructicola causes severe losses, especially on stone fruits (*Prunus* spp.), both before and after harvest. Heavy losses have been reported in North America on peaches, cherries and plums. Losses of 1 million AUD occurred on peaches in 1969 in the Murrumbidgee area (Australia), and heavy losses have also been reported on apricots in Tasmania.

Control

Zehr (1982) reviewed control methods in North America. Control can be achieved by chemical and biological means as well as by the utilization of resistant cultivars. Chemical control is not without problems, even though benomyl and thiophanate-methyl (Montero *et al*., 1985), vinclozolin (Brackmann *et al.*, 1984), iprodione and triforine (Harman & Beever, 1987), and bitertanol (Takamura & Ochiai, 1989) have been reported to be very effective against the fungus. The need to spray several times during the growing period in stone fruit orchards has led to a build-up of fungicide resistance in *M. fructicola*. Strains of *M. fructicola* resistant to most of the commonly used fungicides can be found, especially to benzimidazoles (Elmer & Gaunt, 1986) and dicarboximides (Elmer & Gaunt, 1988).

Studies in New Zealand showed that, out of 1292 naturally sampled isolates of *M. fructicola*, 19% were tolerant of dicarboximides (Elmer & Gaunt, 1986). In laboratory studies, strains were selected which showed resistance to sterol biosynthesis inhibitors, demethylation inhibitors and morpholine (Nuninger-Ney *et al.*, 1989).

Biological control of *M. fructicola* is concentrating on the use of *Bacillus subtilis*. This organism has been reported as very effective against the pathogen, and is particularly used in the post-harvest control of brown rot, where it can be as effective as benomyl (Pusey, 1989).

Another way to avoid losses due to brown rot is by using resistant cultivars. There are several cultivars available which are especially resistant to fruit infection (Layne, 1985; Feliciano *et al.*, 1987).

Phytosanitary risk

M. fructicola is an EPPO A1 pest (OEPP/EPPO, 1988) and is also a quarantine pest for IAPSC. The fact that *M. fructicola* seems to be more variable and adaptable than the European species *M. fructigena* and *M. laxa* (perhaps associated with the more frequent occurrence of the teleomorph) means that it is likely to cause serious losses in the EPPO region in situations where the European species are not significant. It may be noted that, for Australia, *M. fructigena* is the dangerous quarantine pest (Commonwealth Department of Health, 1984).

PHYTOSANITARY MEASURES

Since symptoms on planting material are likely to be insignificant, it may be most prudent to prohibit its entry from countries where *M. fructicola* occurs. Alternatively, such planting material should come from a recognized certification scheme, in a region where *M. fructicola* does not occur.

Fruits of *Prunus* spp., apples and pears from infested countries in the northern hemisphere will arrive in Europe at a time when there is a relatively low risk that fruit trees might be infected. However, fruits from the southern hemisphere will arrive at a high-risk period, and particular care should be given to their inspection. They should come from an area where *M. fructicola* does not occur or the consignment should come from a source found free from *M. fructicola* 6 weeks before harvest and treated according to an EPPO-recommended procedure (OEPP/EPPO, 1990).

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