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Data Sheets on Quarantine Pests

Phyllosticta solitaria

IDENTITY

Name: *Phyllosticta solitaria* Ellis & Everhart
Taxonomic position: Fungi: Deuteromycetes: probable anamorph of Dothideales, Ascomycetes
Common names: Apple blotch (English) Blotch du pommier (French)
Rußfleckenkrankheit des Apfels (German)
Bayer computer code: PHYSSL
EPPO A1 list: No. 20
EU Annex designation: I/A1

HOSTS

Apples are the principal host, including cultivated forms and the wild *Malus coronaria*, on which the pathogen was first described. *P. solitaria* has also been reported on *Crataegus* spp. Apples would be the main host throughout the EPPO region, and possibly wild Pomoideae.

GEOGRAPHICAL DISTRIBUTION

P. solitaria is native to North America, and has not been reported to spread, except for its appearance in Canada and an isolated report in Denmark.
EPPO region: Absent. Isolated report from Denmark (Johansen, 1948), but fungus never became established.
North America: Canada (New Brunswick since 1963 only), USA (east of the Rocky Mountains, from New Jersey to Nebraska and to the southern limits of apple growing in the Mississippi valley).
EU: Absent.

BIOLOGY

Primary infection occurs about 2-3 weeks after blossom fall; overwintering cankers are probably the exclusive source of primary inoculum. Canker enlargement may occur in winter in Illinois (USA) during prolonged warm, moist periods, but it usually begins in the spring, and is accompanied by the formation of true pycnidia. The rainsplash-dispersed pycnidiospores infect the current year's growth, with new cankers appearing in August. The radius of infection in wind-blown rain from a 10-m tree was estimated to be 80 m, with 100% infection within 12 m; however, average tree size in present-day orchards is much less than 10 m. Lesions also occur on the leaves and fruit. Infections arising after July-August bear only pycnosclerotia, which either remain sterile or give rise to pycnidiospores the following spring.

Primary lesions on fruit and foliage are important inoculum sources for summer infections. On fruit, pycnidia, which have already functioned in the season, fill up and become typical pycnosclerotia in the autumn, in which stage they overwinter.

Overwintering pycnosclerotia on mummified fruit and fallen leaves give rise to pycnidiospores in the spring, but their role as inoculum is probably negligible; many overwintering pycnosclerotia become sterile. Fungal mycelium can overwinter indefinitely in twig cankers of some cultivars while, in others, natural excision occurs within 3-4 years; spores will be produced each spring from these cankers. The ascigerous stage has not been found, but probably occurs in the spring as one of the final stages of the pycnosclerotium.

Disease incidence and severity are directly correlated with rainfall; in years with frequent rain, 50% or more of the fruits in many orchards may be affected. There are varying reports on effects of temperature on the fungus (Gardner *et al*., 1923; Guba, 1924; Burgert, 1934) and the temperature requirements observed do not explain the distribution of *P. solitaria* in nature. The pathogen is able to survive long periods (at least 9 months) of cold storage at 1-2°C (McClintock, 1930). The minimum temperature at which spore germination will occur in culture is around 5-10°C, the maximum 30-39°C, and the optimum for growth and spore germination 21-27°C. Light has no effect on cultures of the fungus.

For more information, see Gardner *et al*. (1923), Guba (1924), Roberts & Pierce (1926), Rolfs (1942).

DETECTION AND IDENTIFICATION

Symptoms

On leaves

Tiny white spots, 1.5-3 mm in diameter, first appear between or on the veins and petioles. The spots enlarge, up to 6 mm, and become elliptical, sunken, tan or buff lesions with a black spot (pycnidium) forming in the centre. This infection is of little consequence in itself, but infection at the petiole base may cause defoliation by midsummer. Leaves often remain uninfected.

On twigs, watersprouts and fruit spurs

Roughly circular, dark, raised spots studded with tiny projecting pycnidia develop. These infections may either be the result of a direct spore infection or may arise from the fungus passing from the petiole of the leaf to the wood. Slightly sunken, brown to black cankers develop. In the second year, the central part of the canker is surrounded by a dark border which indicates the extent of the fungus. Pycnidia form in the border area. In the third season, an additional boundary zone forms. As cankers enlarge, they may coalesce and so girdle the twigs. The fungus does not penetrate the wood deeply and lesions may be separated by a callus layer. Dead tissues subsequently slough off.

On fruit

The earliest symptom, which may often go unnoticed, consists of isolated, dark-coloured, semi-hemispherical, raised or blister-like areas, 3 mm in diameter, on the young fruits in late May and early June. These lesions gradually enlarge and develop fringed but distinct margins, with a star-like appearance. The fruit may crack and so provide entry sites for secondary rot fungi. On yellow-skinned cultivars, the spots frequently have a reddish margin.

For more information, see Gardner *et al*. (1923), Guba (1924), Roberts & Pierce (1926), Rolfs (1942).

Morphology

The ascigerous stage of *P. solitaria* is not known, but fructifications on fallen leaves in spring, resembling unripe ascomata, have been observed. No spermatial state is known.

Pycnidia are variable in size and shape according to the organs affected. On leaf spots, pycnidia are minute, thin-walled, globose or subglobose, 60-95 µm, with a rostrate ostiole 9-12 x 7-12 µm. On petioles, pycnidia are larger, 62-119 µm, with an ostiole 12-14 x 9-12

µm. On fruits, pycnidia are depressed, elliptical, thick-walled, 57-95 x 107-166 µm, the stoma being 12-23 µm, the side walls 14-16 µm thick and the basal wall about 4.75 µm thick. On bark, there are two types of fruiting body: pycnidia and pycnosclerotia; the former are similar to those on fruit, but develop a distinct ostiole and have walls of limited thickness.

Conidia are ovoid or broadly elliptic, seldom subglobose, pyriform when young, with a truncate base, broadly rounded and indistinctly indented apically, unicellular, hyaline, smooth walled; 7-11 x 6-8.5 µm, surrounded by a thick slime layer, containing a mixture of numerous, fine and coarse guttules, with 5-15 distinct apical appendages usually 7-9 µm long.

Pycnosclerotia are pycnidia containing a pseudoparenchyma of large cells. They are globose or subglobose, 115-274 x 107-238 µm; ostiole 23-59 µm thick. Pycnosclerotial spores bear a long, narrow, gelatinous, hyaline appendage, considerably broadened at the base to cover about half the spore (Guba, 1924; Van der Aa, 1973).

MEANS OF MOVEMENT AND DISPERSAL

P. solitaria is only locally dispersed by its rain-splashed conidia. International movement is only likely on seedlings or planting material with cankers. The ability of the fungus to withstand long periods of cold storage should be noted (McClintock, 1930).

PEST SIGNIFICANCE

Economic impact

P. solitaria causes a serious blotching of apples which reduces fruit quality. Losses were reported in the past to vary between 5 and 10%, damage being greatest in the middle states of the USA. In Illinois, in 1924, annual losses of approximately 6000 t were recorded, blotch being second only to scab (*Venturia inaequalis*) in seriousness; in unsprayed orchards, all trees and up to 90% of the fruit were affected. In 1925, apple blotch had not caused appreciable damage north of the 42nd parallel. Since there are no recent publications on this pathogen, it is clear that its economic importance has declined, probably in connection with regular fungicide treatment of orchards against more important diseases. A recent description of the disease characterized its occurrence as rare (Yoder, 1990).

Control

The disease can be avoided by planting disease-free nursery material as well as the utilization of resistant cultivars (Yoder, 1990). Control by eradication of cankers is not practical, profitable or even successful; however, sprays of lime sulphur, Bordeaux mixture and dithiocarbamate fungicides (ferbam, zineb, thiram or captan) were reported to give satisfactory control. For more information, see Gardner (1923), Talbert (1924), Roberts & Pierce (1926), Strubble & Morrison (1961).

Phytosanitary risk

P. solitaria has been listed as an A1 quarantine organism by EPPO (OEPP/EPPO, 1980) and is also of quarantine significance for COSAVE. It evidently presents a certain risk for European apple orchards, where no very similar pathogen occurs. It should, however, be noted that its importance in North America has considerably declined and that it is now rare there. It is also presumably easily controlled by modern fungicide treatments.

PHYTOSANITARY MEASURES

EPPO recommends that plants for planting of *Crataegus* and *Malus* (except seeds and tissue cultures) should have been subject to a growing-season inspection at the place of production and should have been subjected to intensive treatment against *P. solitaria* (OEPP/EPPO, 1990).

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