Data Sheets on Quarantine Pests

Melampsora medusae

IDENTITY

Name: *Melampsora medusae* Thümen
Synonyms: *Melampsora albertensis* J.C. Arthur
Anamorph: *Caeoma faulliana* Hunter (aecial state)
Uredo medusae Thümen (uredinial state)
Taxonomic position: Fungi: Basidiomycetes: Uredinales
Common names: Poplar rust (English)
Rouille du peuplier (French)
Pappelrost (German)
Roya del chopo (Spanish)
Bayer computer code: MELMME
EPPO A2 list: No. 74
EU Annex designation: I/A2

HOSTS

The primary telial hosts of *M. medusae* are *Populus* spp., especially *P. balsamifera*, *P. deltoides*, *P. nigra* var. *italica*, *P. tremuloides* and their hybrids and cultivars. The secondary aecial hosts are conifers. In Canada, *Larix* spp., *Pseudotsuga* spp. and young *Pinus* spp. are the principal hosts for the aecial state of the fungus (Ziller, 1965; 1974). For more information, see Walker & Hartigan (1972).

GEOGRAPHICAL DISTRIBUTION

M. medusae is indigenous to North America and has spread from there to other continents. However, its status in Europe is obscure. Reports from Argentina, Spain and Uruguay are based on single doubtful records, especially the records from Argentina and Uruguay (Walker, 1975), which may refer to other *Melampsora* spp.
EPPO region: Belgium, France, Portugal (South), Spain (single record).
Asia: Japan.
Africa: South Africa, Zimbabwe (Trench *et al.*, 1987).
North America: Canada (British Columbia to Newfoundland and Nova Scotia), Mexico (Baja California), USA (practically throughout, including Alaska).
South America: Bolivia, Brazil (Minas Gerais, São Paulo). Doubtful records from Argentina, Chile and Uruguay.
Oceania: Australia (New South Wales, Queensland, South Australia, Victoria), New Zealand.
EU: Present.
Distribution map: See CMI (1991, No. 547).

BIOLOGY

M. medusae is heteroecious but, in mild climates, the urediniospore stage is able to overwinter in buds and bark of *Populus* spp. without the need for an alternate host. Basidiospores from overwintered telia on *Populus* infect conifer needle leaves in the spring. Pycnia and aecia are produced on these leaves, and aeciospores, which may be carried over long distances in the wind, infect susceptible *Populus* spp. in the summer; these spores cannot reinfect the conifer hosts. The urediniospores produced on *Populus* can also be carried long distances by wind. Urediniospores are the main source of inoculum in the Southern Hemisphere and warmer regions of the Northern Hemisphere, in which the overwintering of teliospores with the subsequent spring formation of basidiospores and their infestation of coniferous hosts has not yet been observed (Walker, 1975).

The penetration of *Populus* leaves by the fungus is accomplished by germ tubes which are formed by the urediniospores. These germ tubes follow the leaf surface and enter the leaf through the stomata with or without forming appressoria. Substomatal vesicles are formed which extend and delimit several cells, of which one functions as the haustorial mother cell; this forms an appressorium and finally establishes the host infection (Spiers & Hopcroft, 1988).

Wet, warm and humid weather conditions favour rapid spread of the disease. For more information, see Hepting (1971), McMillan (1972), Ziller (1974), Spiers & Hopcroft (1985; 1988).

Studies on different *M. medusae* isolates showed the occurrence of several distinct races of the fungus which also varied in their aggressiveness (Prakash & Thielges, 1987). This diversity of virulence is mainly influenced by temperature (Prakash & Thielges, 1989), but also by geographical location. In experiments, isolates from a northern latitude were more aggressive than isolates sampled at a more southern latitude (Prakash & Thielges, 1987). Shain (1988) presented evidence for the existence of *formae speciales* in poplar leaf rust and named them *M. medusae* f.sp. *deltoides* and *M. medusae* f.sp. *tremuloides* according to their primary hosts *Populus deltoides* and *P. tremuloides*, respectively.

DETECTION AND IDENTIFICATION

Symptoms

On *Populus*

The first symptoms of infection are yellowish spots, bearing uredinia, which appear within 2-3 weeks on the underside of the leaves (or both sides, in heavy infections). Lower leaves are affected first and then infection spreads over the whole tree; the leaves dry up and fall prematurely. Trees may be stripped of all foliage within 3 weeks. Similar symptoms may be caused by other *Melampsora* spp. which are widespread on *Populus* in Europe (*M. populnea*, *M. larici-populina*).

On conifers

The current year's needles become discoloured and necrotic and bear pycnia and aecia; these sporulating bodies may occasionally be found on cones and rarely on young shoots. The infected leaves die and fall.

For more information, see Ziller (1955), Hepting (1971), McMillan (1972), Walker & Hartigan (1972), Sharma & Heather (1977).

Morphology

In general, size measurements of *M. medusae* spores are not sufficient for positive identification, although surface structure may be diagnostic.

Aeciospores 16-21 x 19-26 µm, with wall bilaterally thickened (3-4 µm) on opposite sides. Urediniospores ellipsoid or obovoid, with wall as aeciospores, and with smooth areas

at the equator; the smooth areas are best seen when spores are trapped in air bubbles; therefore, when making mounts, the cover slip should be dropped on quickly to include as many bubbles as possible; use x40 objective; varying size measurements reported: 22-30 x 15-18 µm; 26-35 x 16-23 µm; 25-35 x 14-22 µm; 22-32 x 12-18 to 25-38 x 15-20 µm. Teliospores 10-15 x 29-45 µm, with wall evenly thick; however, their diagnostic value is too uncertain to be of use.

For more information, see Kraayenoord *et al.* (1974), Ziller (1974).

MEANS OF MOVEMENT AND DISPERSAL

M. medusae has a high potential for natural spread. Urediniospores and aeciospores of the pathogen can be spread by wind over long distances. Nagarajan & Singh (1990) stated that urediniospores, once they reach an altitude of 1.5-2.0 km, can spread a disease transatlantically and quoted the spread of coffee leaf rust, *Hemileia vastatrix*, from Angola to Brazil in 1966 as an example of this wind-borne transatlantic spread of rust fungi.

Successful airborne spread of *M. medusae* has been reported regarding the introduction of the fungus into New Zealand in 1973. From Australia, where the pathogen had been first recorded in 1972, the fungus spread 2000 km by wind to the islands of New Zealand where it was detected in March 1973. High correlations were calculated between the wind patterns in this area and the infected sites in Australia and the newly detected infestation sites in New Zealand (Brown, 1984).

In international trade, the pathogen can also be spread on infected planting material of the various hosts.

PEST SIGNIFICANCE

Economic impact

Severe damage results from premature leaf drop and loss of vigour in young susceptible trees of *Populus* spp., and also *Larix*, *Pinus* and *Pseudotsuga* spp. In New South Wales, Australia, the disease spread over 1200 ha in 6 weeks (Walker & Hartigan, 1972). It is very damaging in both Australia and New Zealand, where *Populus* has been introduced into a new environment. However, in western Canada where the rust is native, extensive damage has also been reported to conifers and *Populus* spp. in nurseries and plantations as well as in natural forests.

The rust has been reported in France at sporadic intervals for 30 years but is rare and of no economic significance. This is mainly due to environmental factors which seem to limit its spread, because of overwintering problems, host alternation and ecological constraints (Pinon, 1986). It should be recalled that the other European *Melampsora* spp. cause very similar diseases on European *Populus* spp., and have been, up till now, of much greater significance.

M. medusae has spread rapidly in Australia and New Zealand and this emphasizes the potential threat to *Populus* spp. as well as to *Larix* and *Pseudotsuga* spp. The susceptibility and uniformity of the *Populus* stands encountered may facilitate spread.

Control

Some resistant *Populus* cultivars are available and can be indirectly selected for resistance by the number and rate of closure of the stomata (Siwecky, 1974). Prakesh & Heather (1989) reported on the partial resistance of *P. deltoides* clones against two races of *M. medusae*, but also stressed the need for maintaining a wide host diversity to manage the disease.

Biological control experiments in the glasshouse on *Pseudotsuga menziesii* were successful using *Bacillus* spp. against the rust (McBride, 1965).

Phytosanitary risk

M. medusae is considered to be an A2 quarantine pest for EPPO (OEPP/EPPO, 1982) and of quarantine significance for IAPSC. The case for its quarantine status in the EPPO region is complex. The forms present in Europe do not seem aggressive and have had no tendency to spread; as such, they present little risk to other European countries. However, there is a risk that one of the known aggressive races of *M. medusae* might be introduced into the EPPO region, which could then cause serious losses, particularly in areas with a mild winter where no alternate host is required. It may be noted that *M. medusae* is the only poplar rust known to spread without its alternate host; the other European species cannot.

Italian *Populus* hybrids are reported to be less susceptible, while *P. nigra* var. *italica* appears tolerant and the *Populus yunnanensis* is very resistant; thus, where these species are grown, the fungus might be less of a hazard. But the adaptability of the different races to changed environmental factors (Prakash & Heather, 1985) as well as different host preferences of different races could lead to serious losses. For more information, see Schipper & Dawson (1974).

PHYTOSANITARY MEASURES

Plants for planting and cut branches of *Abies*, *Larix*, *Picea*, *Pinus*, *Populus*, *Pseudotsuga* and *Tsuga* should have been grown in an area where *M. medusae* does not occur and the place of production should have been found free from the rust during the last growing season (OEPP/EPPO, 1990).

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