

Data Sheets on Quarantine Pests

*Gymnosporangium asiaticum***IDENTITY**

Name: *Gymnosporangium asiaticum* Miyabe ex Yamada

Synonyms: *Gymnosporangium haraeaeum* H. Sydow & Sydow

Gymnosporangium chinense Long

Gymnosporangium koreaense Jackson

Gymnosporangium spiniferum H. Sydow & Sydow

Anamorph: *Roestelia koreaensis* P. Hennings

Taxonomic position: Fungi: Basidiomycetes: Uredinales

Common names: Japanese pear rust (English)

Notes on taxonomy and nomenclature: For information on the taxonomy of *Gymnosporangium* spp., see Kern (1973). Another species *G. shiraianum* K. Hara, occurring only in Japan with pear as the aecial host and *Juniperus conferta* (an ornamental plant of very minor importance, hardly occurring in Europe) as the telial host, is relatively little known. It presents an insignificant risk.

Bayer computer code: GYMNAS

EPPO A1 list: No. 13

EU Annex designation: I/A1 - as *Gymnosporangium* spp. (non-European)

HOSTS

The most important aecial host is Japanese pear (*Pyrus pyrifolia*), and possibly other Asian pear species. European pear (*P. communis*) and quince (*Cydonia oblonga*) are recorded as hosts, but there is little information to suggest that they are significant hosts. Tai (1933) noted that, in China, most foreign pear cultivars were immune; a few were slightly susceptible, but much less so than Japanese pear (the cultivars concerned are not currently grown in Europe). In Japan, neither of the two races of the fungus described by Sakuma (1992) gave more than tiny limited lesions on *P. communis*. Other hosts, in subfamily Pomoideae of the Rosaceae, are *Chaenomeles*, *Crataegus* and *Photinia*. The telial hosts in Asia, *Juniperus chinensis* and the closely related *J. procumbens*, are not native to Europe. The former is widely grown as an ornamental tree or dwarf ornamental, or bonsai plant. In western North America, the alternate host is introduced *J. chinensis* (Ziller, 1974). It is not clear whether any other *Juniperus* spp. have been found infected in North America.

GEOGRAPHICAL DISTRIBUTION

EPPO region: Russia (but only Far East).

North America: Canada (found but not established in British Columbia; Ziller, 1974), USA - established on *Pyrus pyrifolia* and *Juniperus chinensis* in Oregon and Washington (Ziller, 1974); has been found in some other states (California, Connecticut, Wisconsin), but said to be of sporadic occurrence, on ornamentals.

Asia: China (Anhui, Fujian, Guangdong, Gansu, Guangxi, Guizhou, Hebei, Hubei, Henan, Hunan, Jilin, Jiangsu, Jiangxi, Liaoning, Sichuan, Shandong, Shaanxi, Shanxi, Xinjiang, Yunnan, Zhejiang), Hong Kong (unconfirmed), Japan (Honshu, Ryukyu Archipelago), Korea Democratic People's Republic, Korea Republic, Russia (Far East), Taiwan (unconfirmed).

EU: Absent.

Distribution map: See IMI (1992, No. 530).

BIOLOGY

G. asiaticum, like other *Gymnosporangium* spp., is heteroecious in that it requires *Juniperus* and rosaceous hosts of subfamily Pomoideae to complete its life cycle. Telia are produced on stems and leaves of *J. chinensis* in the spring. In moist conditions, the telia germinate *in situ* and produce basidiospores which are dispersed and are able to infect nearby *Pyrus pyrifolia* (or other rosaceous hosts). Infection of *J. chinensis* by *G. asiaticum* persists for more than 1 year (unpublished work in the UK); indeed, infected twigs are said to release basidiospores over many years (Aldwinckle, 1990).

Infection from basidiospores gives rise to pycnia borne on the upper surface of *Pyrus* leaves; they are visible from late spring to early summer. Lee (1990a) has studied the conditions needed for infection of *P. pyrifolia* leaves by sporidia from *J. chinensis*. Later, aeciospores are produced inside tubular protective sheaths (peridia) on the underside of the leaf. The aeciospores are released when the peridium ruptures and are capable of being wind-borne over long distances to *J. chinensis*. After germinating on *J. chinensis*, an overwintering latent mycelium is produced. Infection of *Pyrus* does not persist after infected leaves have fallen. The telial state appears on *J. chinensis* in the spring to begin the life cycle again. For more information see Tanaka (1922), Peterson (1967).

Sakuma (1992) has described two races of *G. asiaticum*, differentiated by their behaviour on cultivars of *P. pyrifolia*; *P. communis* cv. Bartlett gave a resistant reaction to both. An f.sp. *crataegicola* has been described in China (Wang *et al.*, 1993), on *Crataegus*. However, it is not clear whether strict specificity to *Crataegus* has been confirmed.

DETECTION AND IDENTIFICATION

Symptoms

On *Juniperus chinensis*, telia are produced on leaves and green stems (see Morphology). On *Pyrus pyrifolia*, the most conspicuous symptoms are the appearance of the aecia and pycnia on the leaves (see Morphology).

Morphology

On *Juniperus chinensis*

Telia are formed as small cushions of orange-brown spores, 1-3 mm in diameter, on or among the foliage, on fusiform swellings; ramicolous infection has also been observed. Teliospores are two-celled, ellipsoid, 15-25 x 32-47 µm, wall 1-1.5 µm thick.

On *Pyrus pyrifolia*

Aecia are roestelioid, hypophyllous with the peridia 3-5 mm high x 0.25 mm diameter, white, long and tubular, dehiscent at the apex. The aeciospore mass is rusty-brown. Aeciospores are 17-25 µm in diameter. Details can be found in Laundon (1977).

Detection and inspection methods

The inspection of imported *Juniperus* which may have latent infection is particularly important. A secure quarantine procedure would involve retention under closed conditions for 2 years and frequent inspection during January-May.

MEANS OF MOVEMENT AND DISPERSAL

Under natural conditions, spread of *G. asiaticum* is by basidiospore dispersal to rosaceous hosts, and by wind-borne aeciospores to *Juniperus chinensis*. *Pyrus pyrifolia* trees within 100 m of a *J. chinensis* tree are at high risk of infection, and up to 1000 m in windy situations (Unemoto *et al.*, 1989). In international trade, plants of *J. chinensis* from the Far East (especially bonsai plants) are liable to be infected by *G. asiaticum*. *G. asiaticum* has been intercepted on bonsai *Juniperus* from Japan and Hong Kong. Like other *Gymnosporangium* spp., *G. asiaticum* can be latent during winter (the probable importing period) and may not be detectable at pre-export phytosanitary certification. Infection may also have remained latent on the plants in the previous growing season.

Introduction of *G. asiaticum* on commercial importations of plants of *P. pyrifolia* or other rosaceous hosts is very unlikely as infection is not persistent in the dormant stage. Fruits are not infected.

PEST SIGNIFICANCE

Economic impact

G. asiaticum is reported to be a serious pathogen of *Pyrus pyrifolia* in the Far East. It is also, on its alternate host, one of the most important and widely distributed fungal pests of urban ornamentals (*Juniperus chinensis*) in China (Zhang, 1990). There is no indication that *G. asiaticum* has any practical importance in North America, nor that it causes significant disease of any rosaceous host other than *P. pyrifolia*.

Control

As for some other *Gymnosporangium* spp., some success against *G. asiaticum* has been achieved with sterol-inhibiting fungicides, e.g. myclobutanil (Lee, 1990b). In Japan, *G. asiaticum* was mentioned among the most important target pests for a new triazole fungicide (Ohyama *et al.*, 1988). Differences in susceptibility of *P. pyrifolia* cultivars are known. Suppression of the alternate host (*J. chinensis*) within a certain radius of orchards is recommended, but may be difficult as it is often present in private gardens.

Phytosanitary risk

G. asiaticum is one of the non-European *Gymnosporangium* spp. listed as A1 quarantine organisms by EPPO (OEPP/EPPO, 1983). It is also listed as a quarantine pest by IAPSC and NAPPO. Other *Gymnosporangium* spp. already occur on pears in Europe, e.g. *G. sabinae* with *Juniperus sabina* as alternate host (Smith *et al.*, 1988). The severity of *G. sabinae* infection on pear is determined by the proximity of infected *J. sabina* and, in practice, *G. sabinae* is only of rather moderate importance, in southern Europe only. In favour of the quarantine pest status of *G. asiaticum* is the fact that it could very probably establish in Europe (since *J. chinensis* does occur) and that it does appear to be a more damaging species, on its main host *P. pyrifolia* in the Far East, than its European counterpart is on European pear (*P. communis*) in the EPPO region. Against it is the fact that European pear, though recorded as a host, does not appear to suffer significant damage, that *P. pyrifolia* is a very minor crop in Europe, that European pear-juniper rust is in any case easily controlled, and that the need for specific *Juniperus* spp. (grown only as ornamentals in Europe) could in practice severely limit the area of establishment. On balance, *G. asiaticum* appears to present a much lesser risk than *G. juniperi-virginianae* or *G. yamadae* (EPPO/CABI, 1996). One point concerning *G. asiaticum* is that bonsai junipers present the most likely pathway for entry, and that bonsai plants are in any case under close surveillance for many exotic pests.

PHYTOSANITARY MEASURES

Measures such as those proposed for *G. yamadae* would also be suitable for *G. asiaticum* (EPPO/CABI, 1996).

BIBLIOGRAPHY

- Aldwinckle, H.S. (1990) Rust diseases. In: *Compendium of apple and pear diseases*, pp. 10-14. American Phytopathological Society, St. Paul, USA.
- EPPO/CABI (1996) *Gymnosporangium yamadae*. In: *Quarantine pests for Europe*. 2nd edition (Ed. by Smith, I.M.; McNamara, D.G.; Scott, P.R.; Holderness, M.). CAB INTERNATIONAL, Wallingford, UK.
- IMI (1992) *Distribution Maps of Plant Diseases* No. 530 (edition 2). CAB International, Wallingford, UK.
- Kern, F.D. (1973) *A revised taxonomic account of Gymnosporangium*, 134 pp. Penn State University Press, USA.
- Laundon, G. (1977) *Gymnosporangium asiaticum*. *CMI Descriptions of Pathogenic Fungi and Bacteria* No. 541. CAB International, Wallingford, UK.
- Lee, D.H. (1990a) [Studies on the several factors in relation to pear rust infection caused by *Gymnosporangium asiaticum*]. *Korean Journal of Plant Pathology* **6**, 65-72.
- Lee, D.H. (1990b) [Protective and curative effects of ergosterol biosynthesis inhibitors against pear rust]. *Korean Journal of Plant Pathology* **6**, 343-351.
- OEPP/EPPO (1983) Data sheets on quarantine organisms No. 13, *Gymnosporangium* spp. (non-European). *Bulletin OEPP/EPPO Bulletin* **13** (1).
- Ohyama, H.; Wada, T.; Ishikawa, H.; Chiba, K. (1988) HF-6305, a new triazole fungicide. In: *Brighton Crop Protection Conference. Pests and Diseases - 1988*, pp. 519-526. British Crop Protection Council, Thornton Heath, UK.
- Peterson, R.S. (1967) Studies of juniper rusts. *The West Madrono* **19**, 79-91.
- Sakuma, T. (1992) [Pathogenic races of *Gymnosporangium asiaticum* on Japanese pear and pathogenicity to some species in genus *Pyrus*]. *Bulletin of the Fruit Tree Research Station* No. 22, pp. 67-78.
- Smith, I.M.; Dunez, J.; Lelliott, R.A.; Phillips, D.H.; Archer, S.A. (Editors) (1988) *European handbook of plant diseases*. Blackwell Scientific Publications, Oxford, UK.
- Tai, F.L. (1933) [Pear rust caused by *Gymnosporangium haraeaeum* and its control]. *Nanking Journal* No. 3, 143-152.
- Tanaka, T. (1922) New Japanese fungi. Notes and translations XII. *Mycologia* **14**, 282-287.
- Unemoto, S.; Murata, A.; Nagai, Y. (1989) Dispersal of Japanese pear rust fungus, *Gymnosporangium asiaticum*. *Annals of the Phytopathological Society of Japan* **55**, 250-253.
- Wang, K.; Bai, J.K.; Li, D.H.; Deng, G.Y. (1993) [Identification and biological characteristics of *Gymnosporangium asiaticum* f.sp. *crataegicola* infecting hawthorn]. *Acta Phytopathologica Sinica* **23**, 187-192.
- Zhang, N.T. (1990) [Report of a national survey on diseases of urban ornamental plants]. *Forest Pest and Disease* No. 1, pp. 44-46.
- Ziller, W.G. (1974) *The tree rusts of western Canada*, pp. 120-121. Environment Canada Forestry Service, Ottawa, Canada.