Prepared by CABI and EPPO for the EU
under Contract 90/399003

Data Sheets on Quarantine Pests

Gremmeniella abietina

IDENTITY

Name: *Gremmeniella abietina* (Lagerberg) Morelet
Synonyms: *Ascocalyx abietina* (Lagerberg) Schalpfer
Crumenula abietina Lagerberg
Lagerbergia abietina (Lagerberg) J. Reid
Scleroderris abietina (Lagerberg) Gremmen
Scleroderris lagerbergii Gremmen
Anamorph: *Brunchorstia pinea* (P. Karsten) Höhnel
Synonyms: *Brunchorstia destruens* Eriksson
Brunchorstia pini Allescher
Excipulina pinea P. Karsten
Septoria ponea P. Karsten
Taxonomic position: Fungi: Ascomycetes: Helotiales
Common names: Brunchorstia disease (in Europe), scleroderris canker (in USA) (English)
Déssèchement des rameaux de pin (French)
Kieferntriebsterben (German)
Notes on taxonomy and nomenclature: See Biology
Bayer computer code: GREMAB
EU Annex designation: II/B

HOSTS

The host range of *G. abietina* is mostly confined to species of *Abies*, *Picea* and *Pinus*, which occur widely in the EPPO region. Main hosts are *Picea abies*, *P. contorta* and *Pinus sylvestris*. The following hosts have been recorded: *Abies sachalinensis*, *Larix leptolepis*, *Picea glauca*, *P. mariana*, *P. rubens*, *Pinus banksiana*, *P. cembra*, *P. densiflora*, *P. flexilis*, *P. griffithii*, *P. monticola*, *P. mugo*, *P. nigra* var. *austriaca*, *P. nigra* var. *corsicana*, *P. nigra* var. *maritima*, *P. pinaster*, *P. pinea*, *P. ponderosa*, *P. radiata*, *P. resinosa*, *P. rigida*, *P. sabiniana*, *P. strobus*, *P. thunbergii*, *P. wallichiana*, *Pseudotsuga menziensii*. The five-needled pines seem to be more resistant than the two- and three-needled group (Skilling & O'Brien, 1979). For more information see Phillips & Burdekin (1985).

GEOGRAPHICAL DISTRIBUTION

G. abietina is indigenous to Europe and has spread to parts of eastern North America and Japan.
EPPO region: Present in most European countries: Austria, Belgium, Bulgaria, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Iceland, Italy, Lithuania, Netherlands, Norway, Poland, Romania, Russia (European), Spain, Sweden, Switzerland, UK (England, Scotland), Yugoslavia.

Asia: Georgia, Japan (Hokkaido).
North America: Canada (British Columbia to Newfoundland and Nova Scotia), USA (Maine, Michigan, Minnesota, New Hampshire, New York, Vermont, Wisconsin).
EU: Present.
Distribution map: See CMI (1989, No. 423).

BIOLOGY

The fungus enters the apical buds and developing shoots by germinating conidia or ascospores, especially during cool, wet springs. Wounded needles, buds and shoots are particularly susceptible to infection. In Central Europe, conidia and ascospores are released from November to July (Gremmen, 1968). After entrance, the fungus kills the bud and proceeds downwards into the stem and needle fascicles. Shoots start dying in the following spring from the tips. Needle bases turn orange to brown while the tip may be still green and finally fall off. Small, black pycnidia appear at the base of dead needles or on dead shoot tips throughout the year but more commonly in spring and early autumn. Apothecia occur in the same place as pycnidia but 1 year after the shoots die. The entire crown may be infected, which causes significant loss of foliage,further weakening of the trees due to secondary attack by other fungi and insects, and finally death.

The fungus overwinters as mycelium in the conifer host or as immature fruiting bodies. *G. abietina* is seasonal in its development in the host plant. It is capable of infecting the host while it is actively growing, but rapid development of disease symptoms can take place while the host plant is dormant. Mortality incurred during the development of an epidemic depends on the size of the host plant at the time of infection. Very small trees, such as nursery seedlings, are susceptible and die soon after infection, usually in the first year. Most larger trees take several years to succumb, usually dying one branch at a time.

The presence of free water has been found necessary to induce the discharge of both conidia and ascospores (Skilling, 1969). In addition, the ambient temperature at this time influences both the number of ascospores that are discharged per apothecium and how soon dispersal commences. Maximum spore discharge takes place at approximately 17°C. If free water is available in the form of rain for 4-8 h at approximately 17°C, major spore release will take place (Skilling, 1972).

Climatic conditions such as wet spring and cool summer months, high precipitation, high RH and fog are reported

to favour serious outbreaks of the disease (Butin & Hackelberg, 1978; Votila, 1988). In Japan, the epidemic of 1970 is thought to have been favoured by unusually low (freezing) air temperatures from late September to early October 1969 and a subsequent long period of deep snow (Yokota, 1975).

Three strains of the fungus from Europe, North America and Asia have been identified by immunological and other methods (Dorworth & Krywienczyk, 1975). The European strain is more virulent and has a wider host range than the North American Lake States strain (Skilling & O'Brien, 1979). The latter attacks young trees but does little damage to trees taller than 2 m. Furthermore, it appears that the European strain produces very few apothecia and ascospores in the field. In strong contrast, the Lake States strain produces large numbers of ascospores which are released during May and June. Petrini *et al*. (1989) suggest a different classification. Within *G. abietina*, two varieties are recognized: *G. abietina* var. *abietina*, with the known European and North American races from *Pinus* and the Asian race from *Abies sachalinensis*; *G. abietina* var. *balsamea*, comprising the isolates from *Picea* and *Abies*. A new combination is proposed in *Gremmeniella* for *Ascocalyx laricina*. *Ascocalyx abietis* is retained in a separate genus.

DETECTION AND IDENTIFICATION

Symptoms

Initial infection by *G. abietina* occurs in developing shoots in the spring (Gremmen, 1968). However, the first symptoms may not appear until the following winter when resin exudation can be observed on the buds. Brown necrotic areas develop at the base of the buds and in the cortex of the current year's shoot. In the spring, many infected buds fail to flush and the 1-year-old needles turn orange to brown, beginning at the base and gradually extending to the tip, followed by needle-cast as the result of dieback of these shoots. A characteristic yellow coloration of the xylem tissues can also be seen (Read, 1967). When buds are only partially infected, poor, distorted shoots may be produced. Infected shoots may also survive, in which case areas of depressed necrotic tissue may be found. At this stage affected trees have many dead shoots in the crown and, if the attack is severe, some trees will die. One year later bunches of light-green needles may develop from adventitious buds, present at the base of the dead shoots and sometimes giving the appearance of small witches' brooms. However, trees often survive and adventitious buds develop below the point of dieback to provide new growth (Gremmen, 1972).

In Norway, the presence of girdling cankers on small *Pinus sylvestris* 0.5-2 m in height has been reported (Roll-Hansen, 1964). In *P. banksiana*, elongated cankers above the ground line cause a girdling of the stem above which the entire tree is killed. Flagging on lower branches may occur as in *P. resinosa* and sometimes basal cankers (Ohman, 1966). In *P. nigra*, as well as in *P. nigra* subsp. *laricio*, abundant pycnidia and apothecia appear after the shoots have been killed. Pycnidia occur mainly on cankers and needle bases. On *P. abies*, pycnidia only develop on needle cushions. No apothecia have been found on this host.

Pine seedlings in the nursery should be inspected for orange to brown discoloration at the base of needles in early May. By July, needles and branch tips become brown. Needles fall from branch tips when the slightest pressure is applied. In young pine trees, green discoloration appears beneath the bark of dead branches. Stem cankers are rare but small branch cankers are commonly found. Throughout the year, but mostly in spring and early autumn, black pycnidia or light-brown apothecia should be visible at the base of dead needles or on dead branch tips.

Morphology

Pycnidia occur on stems and needles, are gregarious or solitary, dark-brown to black, stromatic, multilocular, without ostioles, up to 1 mm wide; the wall is several cells thick, composed of outer sclerotized and heavily pigmented cells and inner wall pseudoparenchyma. Conidiophores completely line the inside of the pycnidial cavity, are hyaline, cylindrical. Conidia (blastospores) hyaline, cylindrical, somewhat curved, tapering towards the apices, mostly three-septate, not constricted at the septum, 25-40 x 3-3.5 µm.

Apothecia appear on stems and axes of the needles, gregarious, erumpent, superficial, about 1 mm diameter, with short stipes. Hymenium cream-coloured, receptacle dark-brown to black, margin opaque. Excipulum composed of several layers of polygonal cells heavily pigmented and sclerotized towards the margin and provided with irregular cell protuberances on the outside. Asci subclavate, short-stipitate, inoperculate, eight-spored, 100-120 x 8-10 µm; ascus wall bitunicate. Ascospores biseriate, hyaline, ellipsoidal, sometimes slightly curved, ends rounded, mature spores three-septate not constricted at the septum, 15-22 x 3-5 µm. Paraphyses hyaline, filiform, septate (Punithalingam & Gibson, 1973).

MEANS OF MOVEMENT AND DISPERSAL

Conidia liberated from infected tissues are dispersed under wet conditions by a water splash mechanism (Votila, 1985). Long-distance dispersal of the fungus is thought to occur largely through wind-borne ascospores. Absence of ascospores in the European strain clearly has implications for disease spread. Transport of infected nursery stock or movement of infected Christmas trees of *P. sylvestris* may provide alternative means of long-distance dispersal. Magasi & Manley (1974) showed that *G. abietina* can survive for a period of 10 days in branches of 9-year-old *P. sylvestris* trees cut for the Christmas tree trade, regardless of whether they are left outdoors or brought indoors and subjected to dry, warm conditions.

PEST SIGNIFICANCE

Economic impact

Brunchorstia dieback was reported to have devastated*Pinus nigra* var. *maritima* in Scandinavia in about 1880 and to have severely attacked *P. cembra* in Sweden in recent years. In the UK, it occurs mainly on *P. nigra* var. *maritima* and only occasionally on *P. sylvestris*. It has also caused loss to *Picea abies* in continental Europe over the last century.

G. abietina was first identified in North America in 1962 and since then has been an increasing threat to *Picea*, *Pinus resinosa* and *P. sylvestris* forests.

The disease is typified by death of the growing point and the apical needles of the lower branches of pine and spruce. Under severe conditions all the foliage of the host may be affected and die. It is most damaging to species that are grown towards the limit of their range and attacks are favoured by shaded conditions, by dense, badly aerated plantations in which humidity is high, and by weather damage, such as temperature oscillations during shoot elongation. The disease may kill young trees as well as reducing growth and causing distortion of older trees. It can also cause serious nursery loss.

Control

The disease may be controlled in the nursery using the fungicide chlorothalonil applied about seven times fromMay to mid-August (Skilling & Waddell, 1970; 1974). On the forest scale, however, once *G. abietina* is established in a plantation it is almost impossible to control. The use of chemicals is not practicable in plantation crops where careful selection of disease-free planting material, as well as selection of planting sites at some distance from affected plantations, are important considerations.

Phytosanitary risk

G. abietina has not been classified as a quarantine pest by EPPO, but is of quarantine significance for NAPPO, and potentially in other regions. In Europe, it has generally been regarded as widespread and to have reached the limits of its natural distribution. Its absence from certainareas has been simply attributed to the fact that they lie outside the natural range of the fungus. There is certainly no strong suggestion that *G. abietina* has potential to cause direct damage in such areas. However, its presence, even at relatively insignificant levels, could have indirect consequences for the export trade.

PHYTOSANITARY MEASURES

Planting material of tree species included in the host range of *G. abietina* should be chemically treated with the fungicide chlorothalonil prior to movement. Before export to countries free from the disease, Christmas trees should be inspected for canker during the summer before trading. Immersion of diseased seedlings in warm water (55°C) and immersion or spraying with dilute sodium hypochlorite eradicated the pathogen with no

apparent loss in needle colour or retention (Hudler & Neal, 1990). Regulatory action by the USA and Canada now prohibits the movement of Christmas trees and nursery stock from areas where the European strain is present.

In affected plantations, the optimum time to carry out sanitation fellings is the first winter after symptoms of the disease have appeared.

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