Two leaf pathogens of *Ribes* spp. in North America, *Quasiphloeospora saximontanensis* and *Phloeosporella ribis*

B. C. SUTTON1, S. F. SHAMOUN2 AND P. W. CROUS3

1 International Mycological Institute, Bakelham Lane, Egham, Surrey TW20 9TY, U.K.
2 Natural Resources Canada, Canadian Forest Service, Pacific Forestry Centre, 506 West Burnside Rd, Victoria, B.C., V8Z 1M5 Canada
3 Department of Plant Pathology, University of Stellenbosch, 7600 Stellenbosch, South Africa

The generic name *Quasiphloeospora*, type species *Q. saximontanensis* comb. nov., is introduced for a species associated with foliar lesions on the forest weed *Ribes viscissimum* and other species of *Ribes*. It is compared with similar genera and species of hyphomycetes and coelomycetes, especially *Phloeosporella ribis* comb. nov. with which it has been confused.

Competing weeds in the forest renewal sites of British Columbia (B.C.) are important reservoirs of plant pathogenic fungi. Traditionally, chemical herbicides, manual cutting and controlled burning have been used to control the growth of forest weeds, but increasing public opposition to these methods has caused much research to be directed toward development of biological control agents (mycoherbicides) (Dorworth, 1990; Wall & Shamoun, 1990; Wall, Prasad & Shamoun, 1992).

In the summer of 1993, the junior author (S.F.S.) and his colleagues at the Pacific Forestry Centre conducted a field survey and collected fungi from diseased forest weeds and shrubs for screening and evaluation of their use as potential biocontrol agents against these weeds. Disease symptoms associated with a fungal infection were observed on foliage of sticky currant (*Ribes viscissimum* Pursh) and the causal fungus identified as *Cercospora saximontanensis* Deighton. The weed is considered to be a major competitor with respect to moisture, nutrients and space in the reforestation sites of coastal and interior B.C. It also acts as an alternate host to white pine (Pinus monticola Doug., ex D. Don) blister rust disease caused by *Cronartium ribicola* J. C. Fisch., and is therefore an important limiting factor to the regeneration of these trees. The aim of the present study was to characterize this species and distinguish it from other known species on this host substratum as a prerequisite to any strategies for its potential use as a biocontrol agent.

**MATERIALS AND METHODS**

Diseased leaf samples of sticky currant were collected and conidium development was examined by SEM. Leaf discs bearing conidiomata (approximately 7 × 7 mm) were fixed in glutaraldehyde, followed by 1% osmium tetroxide in a 0.1 M phosphate buffer, dehydrated in a graded acetone series, critical point dried and mounted. Specimens were coated with gold–palladium and viewed with a JSM 6400 scanning electron microscope. All measurements were obtained by mounting specimens in lactophenol cotton blue, and observing them under the 100 × (oil) objective of a light microscope. Material was compared and contrasted with holdings in herb. IMI.

**Quasiphloeospora** B. Sutton, Crous & Shamoun, gen. nov. (Figs 1–7)


Typus generis: *Quasiphloeospora saximontanensis* (Deighton) B. Sutton, Crous & Shamoun.

Folicolous, associated with lesions. *Mycelium* internal, brown, branched, septate. *Conidiomata* separate, acervular to sporodochial, epidermal to subepidermal, composed of brown *textura angularis* at the base and *textura prismatica* above. *Conidiophores* brown, verruculose, irregularly branched at the base, septate, cylindrical, formed from the upper cells of the conidiomata. *Conidiogenous cells* integrated, terminal or lateral, smooth or verruculose, brown, cylindrical, straight, proliferating percurrently and enteroblastically to form annellations.
or sympodially and holoblastically. *Conidiogenous loci* dark and thickened. *Conidia* holoblastic, pale brown, smooth, cylindrical, septate, obtuse at the apex and truncate at the base; basal scar dark and thickened.

This newly described genus occupies a position intermediate between the sporodochial hyphomycetes and acervular coelomycetes, but neither Sutton (1973, 1980) nor Nag Raj (1981) consider conidiomatal structure to be of primary systematic significance in these groups. In determining the relationships of this species account should be taken of the published literature in both groups. The more compact arrangement of conidiophores suggests placement of *Quasiphleospora* in the coelomycetes rather than the hyphomycetes. However, there are many species of *Pseudocercospora* Speg. (a genus usually placed in the hyphomycetes) where this type of conidiomatal structure also occurs.

In contrast, the nature of scars left on conidiogenous cells and those on conidial hila after secession are increasingly being recognized as vital clues to fundamental relationships in hyphomycetes, and this is especially relevant in the many genera surrounding the *Cercospora* complex (Luttrell, 1963; Deighton, 1973, 1976, 1979; Mangenot & Reisinger, 1976; Pons, Sutton & Gay, 1985; David, 1993). Ultrastructurally the basal scar is composed of only a single-layered wall derived from one half of the secision septum whereas the periclinal wall is double-layered (Cole & Samson, 1980). This sort of arrangement is basic to both unthickened and thickened scars, but in the latter, additional wall material and/or melanin is laid down before, during and after the events leading to secision. The thickened scar at the conidial base in *Quasiphleospora* is the character which really distinguishes this genus from others. In the coelomycetes there is no parallel at all. In genera such as *Colletogloea* Petr., *Phleospora* Wallr., *Ahmadia* Syd., *Anuhysmena* Bubák and others (Sutton, 1980) where there is a basic similarity in conidiogenous events and conidiomorphology, all have thin, unthickened basal scars which show no differences from the periclinal walls of the conidia in examination by optical microscopy. In the hyphomycetes there are many genera in the *Cercospora* complex where conidial scars are thickened in different ways and Deighton (1973, 1976, 1979) has separated a number of genera such as *Cercosorella* Sacc. and *Pseudocercosporidium* Deighton (highly thickened and refractive), and *Panercospora* Deighton (thickening confined to the rim); on this basis, *Pseudocercospora* and *Panercospora* appear closely related to *Quasiphleospora*, but the conidial scars in *Pseudocercospora* are unthickened, and in *Panercospora* the thickening is restricted to the rim of the conidiogenous cell. In *Cercospora* Fresen., where the species on
Quasiphloeospora saximontanensis (Deighton) B. Sutton, Crous & Shamoun, comb. nov.


Lesions amphigenous, light brown to dark red, angular, vein-limited, up to 5 mm diam., occasionally associated with chlorosis extending beyond the areas of sporulation. Mycelium immersed, consisting of smooth, olivaceous to brown inter- and intra-cellular, branched, septate hyphae 1·5–2·5 μm wide. Conidiomata epigenous and hypogenous, abundant, separate, dark brown to black, acervular, sporodochial and hyphal (fasciculate), epidermal to subepidermal, composed at the base of brown textura angularis becoming paler and increasingly more like textura prismatica towards the conidiophore-bearing region, or emerging as fascicles of up to 20 through stomata, 40–130 μm diam. × 50–110 μm high (including the conidiophores). Conidiophores olivaceous to medium brown, irregularly verruculose and branched at the base, becoming less rough above, 1–4-septate, cylindrical, erect, formed from the upper cells of the conidiomata, 35–70 × 3–4·5 μm. Conidiogenous cells integrated, mostly terminal, occasionally lateral, irregularly verruculose, pale brown to olivaceous, cylindrical, straight or slightly flexuous, proliferating percurrently and enteroblastically to form up to 3 annelations, or symподially and holoblastically to form 2–3 loci, 15–45 × 3–4·5 μm. Conidiogenous loci non-protruberant, non-geniculate, dark and thickened, 2–2·5 μm wide. Conidia holoblastic, pale brown to olivaceous, smooth, cylindrical, straight or gently curved, obtuse at the apex and truncate at the gradually or occasionally abruptly tapered base, eguttulate, 1–4-septate, 40–100 × 2·5–3·5 μm; basal scar darker and more thickened than the periclinl wall.


Leaf pathogens of *Ribes* spp.


This species was originally described by Deighton (1983) from *Ribes viscocissum*, *R. sanguineum* Pursh and *R. speciosum* Pursh in North America from material misidentified as *Cercospora ribicola* Ellis & Everh. and *Cercospora septoriopis* Chupp or its synonym *Cercosporidium ribis* (Davis) Dearn. & House. It only has a tenuous relationship to *Cercospora* in having cicatrized conidiogenous loci and filiform conidia. It differs from this genus by the pale brown conidia, the percurrently and sympodially proliferating conidiogenous cells, conidiogenesis associated with such proliferations, verruculose conidiophores and conidiogenous cells, the non-prouberant, non-geniculate conidiogenous loci, and the acervular to sporodochial conidiomata.

*Quasiphloespora saximontanensis* has frequently been misidentified as what was originally known as *Cylindrosporium ribis* Davis, which was later placed in *Cercosporidium Petri* by Dearness & House (1940) and *Cercospora* by Chupp (1954). Since there are no modern accounts of this species and *Cylindrosporium*, *Cercosporidium* and *Cercospora* are not appropriate placements for it, a description with revised nomenclature follows.

**Phloeospora ribis** (Davis) B. Sutton, Crous & Shamoun, comb. nov.

(Figs 8–10)


*Cercosporidium ribis* (Davis) Dearness & House, *Circ. NY State Mus.* 24: 56 (1940).


Lesions amphigenous, pale to medium brown with a narrow purple-brown raised margin, circular to elliptical or irregular, not vein-limited, up to 5 mm diam. Hyphae immersed, consisting of smooth, hyaline inter- and intra-cellular, branched, septate hyphae 1.5–2.5 µm wide. Conidiomata mostly epigeneric but a few hypogenous, abundant, separate, white to cream, acervular, epidermal, subepidermal, composed of hyaline *textura angularis* which is very pale brown at the base of the conidiomata, up to 50 μm diam x 35 µm high (including the conidiophores). Conidiophores hyaline, smooth, branched sparingly at the base, 1–2-septate, mostly cylindrical, erect, formed from the upper cells of the conidiomata, 40 × 3–4 µm. Conidiogenous cells integrated or discrete, smooth, hyaline, cylindrical, straight or slightly flexuous, proliferating sympodially and holoblastically to form up to 2 loci, 15–45 × 3–4.5 µm. Conidiogenous loci non-prouberant, non-geniculate, hyaline, 2 µm wide. Conidia holoblastic, hyaline, smooth, filamentous, irregularly curved, obtuse to acute at the apex and truncate at the gradually tapered base, irregularly guttulate, 1–4-septate, 40–85 × 2.2–5 µm; basal scar hyaline.


The placement of this species in *Cylindrosporium* Grev. is not tenable on account of the lack of unicellular conidia formed from phialides (Sutton, 1980). Rawlinson, Sutton & Muthyalu (1978) showed that the genus is currently monotypic and restricted to *C. concentricum* Grev., the anamorph of *Pyrenopeziza brassicae* B. Sutton & Rawl. *Cercosporidium*, another genus in which this pathogen of *Ribes* spp. has been placed, is inappropriate because the conidia in *Cercosporidium* are brown and often verruculose. Deighton (1976) at first accepted this genus but later (Deighton, 1987) regarded it as a synonym of *Pseudocercospora*. *Cercospora* is also unsuitable because of its hypomyecetic habit and the fact that both conidiogenous loci and conidial scars are prominently thickened (Pons & Sutton, 1988).

*Cylindrosporium ribis* is more correctly placed in *Phloeospora* Höhn. The only modern account of *Phloeospora* is by Sutton (1980) who redescribed the type species, *P. conothi* (Ell. & Everh.) Höhn. and accepted five species; four of which had been formerly placed in *Cylindrosporium*. Characters of the genus are the filiform hyaline septe conidia formed from holoblastic sympodially proliferating conidiogenous cells in acervular conidiomata.
CONCLUSIONS

There have been several fungi referable to the ‘Cercospora complex’ described from foliage of Ribes spp. (Chupp, 1954; Pollack, 1987). Revision of these has been piecemeal. Chupp (1954) thought that C. magellanica Speg. described on R. magellanica Poir. from Argentina might be classed as a Polythecium Kunze. Braun & Rogerson (1993) dealt with C. coelestis Davis on R. interme from Utah, U.S.A. and referred it to Phaeomarulaia Mun.-Cvctk. Deighton (1983) dealt with C. septioripis Chupp (a nomen novum for Cylnodosporeon ribis Davis) and concluded that under this name a number of collections had been misidentified. He accepted the name Cylnodosporeon ribis for some material and segregated the remainder as a new taxon, Cercospora saximontanensis Deighton. It has been shown that these two taxa are indeed distinct but neither are correctly placed in Cercospora. _Cylindrosporium_ ribis (Cercospora septioripis) is referred to Phloeospora and _Cercospora saximontanensis_ is placed in a new genus _Quasi-philospora_. They differ in symptoms, conidial body structure, some aspects of conidiogenous events, conidial morphology and scar structure. For the purposes of quick identification _Q. saximontanensis_ has vein-limited lesions, mostly epigenous sporulation, dark brown to black conidiomata, and the conidia are pale brown with a thickened basal scar. _P. ribis_ has lesions surrounded by a purple raised margin. Sporulation is mostly epigenous, conidiomata are white to cream, and conidia are hyaline with no thickened basal scar.

REFERENCES


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