

Microscopical observations of *Sphaerellopsis filum*, a parasite of *Puccinia recondita*

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Summary

Sphaerellopsis filum is a well-known parasite associated with many species of rust fungi. It is of frequent occurrence as parasite of cereal rusts: *Puccinia recondita*, *P. coronata*, *P. graminis*, *P. hordei* and *P. striiformis*.

Uredial sori of *Puccinia recondita* f.sp. *tritici* infected with *Sphaerellopsis filum* were examined by light and scanning microscope to determine morphology of hyperparasite as well as the parasite-hyperparasite contact. The microscopical examination of infected uredinia clearly showed the intimate connection of *S. filum* with its rust host.

Key words: hyperparasitism, *Sphaerellopsis filum*

INTRODUCTION

Sphaerellopsis filum (Biv. ex Fr.) B.Sutton [*Darluca filum* (Biv. ex Fr.) Castagne], anamorph of *Eudarluca caricis* (Fr.) O. Erikss., is a cosmopolitan hyperparasite associated with 369 rust species belonging to 30 genera. It has been found in more than 50 countries (Kranz and Brandenburger, 1981). It has been mostly reported to penetrate uredial sori, also occasionally the telial and ecial sori as well. *Sphaerellopsis filum* is most commonly observed as anamorph producing clumps of shiny, black spherical pycnidia situated among the spores of uredial sori, where it is presumed to derive nutrients from direct hyphal penetration of uredospores. Because of this penetration, the uredospores number is reduced and spore production in some cases completely stopped. Due to this fact the hyperparasite can potentially be an important biocontrolling factor (Yuan et al., 1998; Kuhlman & Matthews, 1976; Carling et al., 1976; Swendstrud and Calpouzos, 1972).

This study clarifies the hyperparasitic relationship between *Sphaerellopsis filum* and *Puccinia recondita* Rob. ex Desm. f. sp. *tritici* (Erikss.) Johnson, describes the nutrient-securing structures and demonstrates the elements of morphology of hyperparasite.

MATERIAL AND METHODS

Samples of wheat infected with *Puccinia recondita* and *Sphaerellopsis filum* were collected in September 2002 from an experimental field of Department of Plant Pathology in Warsaw. The uredial sori free of *S. filum* infection has been used as control. Light microscopy observations were carried out on a fresh rust infected leaf fragment. Pycnidia were removed from uredial sori, placed on a microscope slide in a drop of distilled water and covered with a cover glass. Dimensions of pycnidia and conidia were measured by examining 10 pycnidia and 50 spores flowing out of a squashed pycnidia.

For scanning electron microscopy small, dry leaf pieces (1 sq. cm diameter) with and without hyperparasite colonies were excised, afterwards thinly coated with carbon and silver in an JEOL JEE-4C vacuum evaporator and finally examined with a JEOL JSM-35 scanning electron microscope operating at 25 kV. The microscopical observations were carried out in the Laboratory of Electron Microscopy of the Warsaw Agricultural University.

RESULTS

The pycnidia of *S. filum* were completely or partly immersed in the uredial sori. They were black, shiny, subglobose, 90-200 μm in diam., and often had distinct ostioles through which a light cream-coloured mass of conidial spores exuded (figs. 1, 2). Conidia were 1-septate, hyaline, fusiform, 13-18x3-5 μm , with a mucous cushion at every end (fig. 3).

The scanning microscope observations show that uredial sori were often completely overgrown with mycelium of *S. filum*. White and loose hyphae of hyperparasite were developed on the pustule surface and inside it (fig. 4). *Sphaerellopsis filum* was intimately associated with *Puccinia recondita* uredospores penetrating spores by specialized structures such as appressoria (fig. 5). Many of the uredospores in contact with a hyperparasite collapsed, disintegrated and were occasionally divested of spikes on the surface of spore walls (fig. 6).



Fig. 1. Pycnidia of *Sphaerellopsis filum* immersed in the uredial sori of *Puccinia recondita* (scale bar: 1 mm)

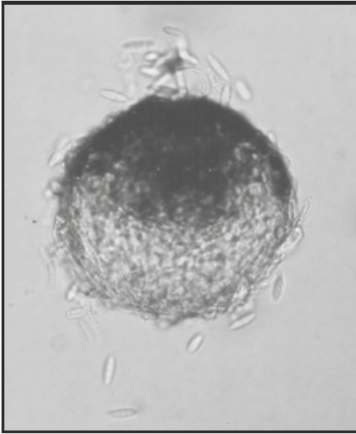


Fig. 2. Pycnidium with ostiole on its top (arrow) and mass of conidial spores (scale bar: 100 μ m)

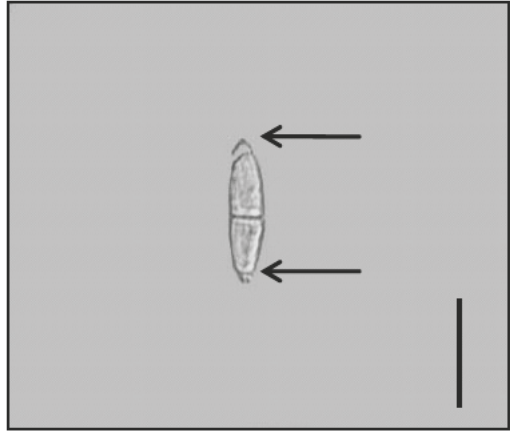


Fig. 3. The typical two celled conidium of *S. filum* with mucous cushions on both tips (arrows) (scale bar: 10 μ m)

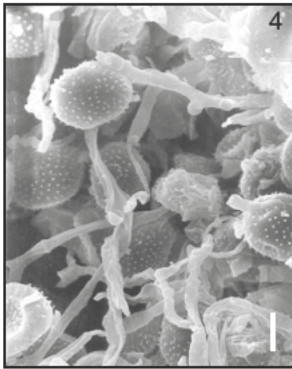


Fig. 4. Scanning electron micrograph of hyphae of *S. filum* developed among the uredospores of *P. recondita* (scale bar: 10 μ m)

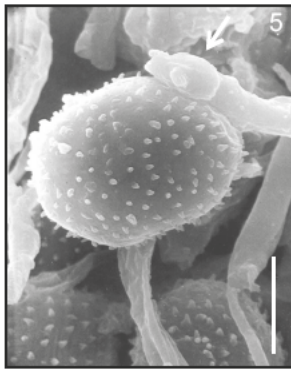


Fig. 5. SEM of appressorium on the surface of the uredospore (arrow) (scale bar: 10 μ m)

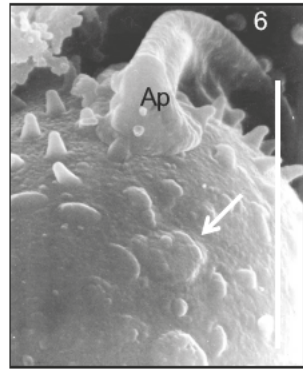


Fig. 6. SEM of uredospore *P. recondita* penetrated by *S. filum* hypha with visible appressorium swelling (Ap) and divested of spikes on the surface of the spore wall (arrow) (scale bar: 10 μ m)

DISCUSSION

Microscope observations of infected uredial sori clearly demonstrated the intimate association of *Sphaerellopsis filum* and *Puccinia recondita*.

Barnett and Binder (1973) classified mycoparasites into two groups. The necrotrophic parasites, which kill the host cells before or just after invasion were assigned to the first group. The dead cells are the nutrients for these parasites. The second group are biotrophs which are able to obtain nutrients from live host cells. These parasites may derive the nutrients forming absorbtive cells of specialized hyphae haustoria and hyphal swellings appressoria.

The previous ultrastructural examination of *Sphaerellopsis filum* (Carling et al., 1976) demonstrated that *S. filum* is a biotroph penetrating and causing the destruction of uredospores of *Puccinia graminis*. Carling affirmed that this penetration may be due to combined mechanical and enzymatic processes, with absence of specialized penetration structures.

This study confirms that *Sphaerellopsis filum* is a biotrophic mycoparasite, whose hyphae parasites on living uredospores, causing their progressive destruction. The specialized hyphae of hyperparasite form swelled structures similar to appressoria adhering to the surface of uredospores (figs. 5, 6). These penetration structures haven't been previously observed.

Observation concerning the morphology of pycnidia and conidia of *S. filum* confirms their previous descriptions (Calpouzos et al., 1957, Yuan et al., 1998).

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Obserwacje mikroskopowe nad *Sphaerellopsis filum*, pasożytem *Puccinia recondita*

Streszczenie

Sphaerellopsis filum jest pospolitym pasożytem wielu gatunków grzybów rdzawnikowych. Bardzo często występuje jako pasożyt rdzy zbożowych takich jak: *Puccinia recondita*, *P. coronata*, *P. graminis*, *P. hordei* i *P. striiformis*.

Przeprowadzono analizę morfologiczną grzyba *Sphaerellopsis filum* oraz struktur anatomicznych służących temu nadpasożytowi do kontaktu z grzybem rdzawnikowym *Puccinia recondita*. Badania wykonano przy użyciu mikroskopu świetlnego i skaningowego. Opisano struktury morfologiczne ssawki wskazujące na związek pasożytniczy między grzybnią *S. filum* i zarodnikami *P. recondita*.

