

# *Phaeosphaeria microscopica* (Karsten) O. Erikss.: FIRST REPORT ON *Deschampsia antarctica* Desv.

(*Phaeosphaeria microscopica* (Karsten) O. Erikss.: primer reporte  
sobre *Deschampsia antarctica* Desv.)

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**Palabras clave:** Antártida, Ascomycota, fissitunicados, *Phaeosphaeria microscopica*

## RESUMEN

*Phaeosphaeria microscopica* (Karsten) O. Eriksson es descrita por primera vez en el presente trabajo desarrollándose sobre "hair grass" (*Deschampsia antarctica* Desv.), uno de los dos únicos pastos autóctonos capaces de crecer en la Antártida. Este hongo se caracteriza por producir ascomas de color pardo rojizo, de localización sub-epidérmica, usualmente globosos y ostiolados, ascos bitunicados y octosporados, y ascosporas compuestas por cuatro células, de paredes lisas, fusiformes a claviformes, y de color pardo rojizo, sin envolturas gelatinosas.

## ABSTRACT

*Phaeosphaeria microscopica* (Karsten) O. Eriksson, is reported herein for the first time growing on "hair grass" (*Deschampsia antarctica* Desv.), one of the both two unique native Antarctic living grass. It is characterised by the sub epidermal, usually globose and ostiolate, reddish-brown ascomata, 8-spored, fissitunicate asci, and four-celled, smooth-walled, fusiform to clavate, reddish-brown ascospores, without gelatinous sheath.

## INTRODUCTION

Antarctica is a continent that has a surface of 5.1 million square miles (13.2 million square kilometres) (Fig. 1), but the area doubles in winter due to the ice formed from freeze seawater. Only 2% of the former is a snow and ice-free land. Most of this area is found along the Antarctic Peninsula, surrounding islands, and coastal regions of the rest of this continent. The Antarctic terrestrial biota is composed already of 80 species of mosses and liverworts, 200 to 300 lichens species, several hundred of non-marine algae, a large number of bacterial and many fungal species, and two native flowering plants,

*Colobanthus quitensis* (Kunth) Bartl. (Caryophyllaceae) and *Deschampsia antarctica* Desv. (Poaceae). These plants provide a habitat for invertebrate, as mites, nematodes, tardigrades and rotifers. In the snow and ice, especially in coastal regions, snow algae may be found as red, green, yellow or grey patches on their surface during the Antarctic summer.

*Deschampsia antarctica* is a highly freezing-tolerant organism (Alberdi & Corcuera, 1991; Bravo *et al.*, 2001). Acclimation experiments showed that *D. antarctica* is able to resist up to -27°C in the lab. It is a caespitose perennial grass that forms dense cushion-like structures, up to 30 cm in diameter and 10 to 20 cm high.

The panicle presents one lax that as soon as it emerges from the cases, small ears display 2 to 3 flowers. It begins to grow in the middle of November by seeds or emit buds or sprouts from the bushes of the previous year. The first flowering happens in the first weeks of January and in the middle of the fertile month already they are ears. In the middle of February it fructifies.

During the summer expedition of the "Instituto Antártico Argentino" to the Antarctica, one of our participants (W. M. C.) collected a number of samples (soil, plant and lichens) from near the "Jubany" Argentinian base (King George Island, South Shetland Islands). An interesting ascomycete was found growing on an exemplar of *D. antarctica*. This is characterised by reddish brown, ostiolate ascomata, fissitunicate asci, and four-celled, smooth-walled, fusiform to clavate, reddish-brown ascospores, without gelatinous sheath. Later was recognised as pertaining to the genus *Phaeosphaeria* Miyake (1909), and constitutes their first report for this substrate.

## MATERIALS AND METHODS

*Deschampsia antarctica* Desv. specimens were collected in Three Brothers Hill, near the "Jubany" Argentinean base (62° 14'S, 58° 40'W), King George Island, South Shetland archipelago (Fig. 1). The soils are characterised by a high content of coarse mineral particles of basaltic origin and organic material, mostly proceeding from the seawater and dejections of seabirds (including penguin and skua), and showing a low C/N ratio and acidic pH. The vegetation is mainly composed of algae (as *Prasiola crispa* (Lightfoot) Meneghini), lichens (as *Acarospora molybdina* (Wahlenb.) Trevisan, *Caloplaca* spp., *Lecidea auriculata* Th. Fr., *Placodium* spp., *Ramalina terebrata* Tayl. & Hook., *Usnea* spp., *Xanthoria elegans* (Link) Th. Fr.), mosses (*Andreaea depressinervis* Card., *A. regularis* C. Müll., *Brachythecium subpilosum* (Hook.f. & Wils.) Jaeg., *Bryum dichotomum* Hedw., *B. muehlenbeckii* Bruch & Schimp., *Callitriche antarctica* Engelm. Ex Hegelm., *Ditrichum austro-georgicum* (Card.) Seppelt, *Drepanocladus uncinatus* (Hedw.) Warnst., *Pogonatum alpinum* (Hedw.) Roehl., *Tortula antarctica* (Hampe) Par., etc.), *Colobanthus quitensis* (Kunth.) Bartl., *Deschampsia antarctica* Desv. and *Poa pratensis* L. (Cabrera, 1994; Lindsay, 1971; Möller and Dreyfuss, 1996). The area is dominated by a cold climate. The following data were reported in 1995: average temperature was -1.5 °C, with a minimum of -19.9 °C and a maximum of 10.4 °C; total annual precipitation was 273 mm and total annual snow was 1257 cm; minimum, average and maximum atmospheric pressure were 946 mb, 989.9

mb and 1025 mb, respectively; average humidity was 88 %.

Plants (Figs 2 and 3) were removed from the ground using ethanol-flamed sterilised metal shovel (Fig. 5) and placed into sterile polyethylene bags, closed by rubber band, and stored in a refrigerator at -20 °C. In the lab, these were dehydrated at 50 °C during 5 days into microbiological incubators, and packaged into paper envelopes. Later, the dry material was re-hydrated into boiling water, examined under stereoscopic microscope, dissected using sterile needles, and mounted on slides. The measurements of the microscopic structures were taken in lacto-phenol. Photomicrographs and draws were obtained with a Leitz Dialux 20 EB microscope.

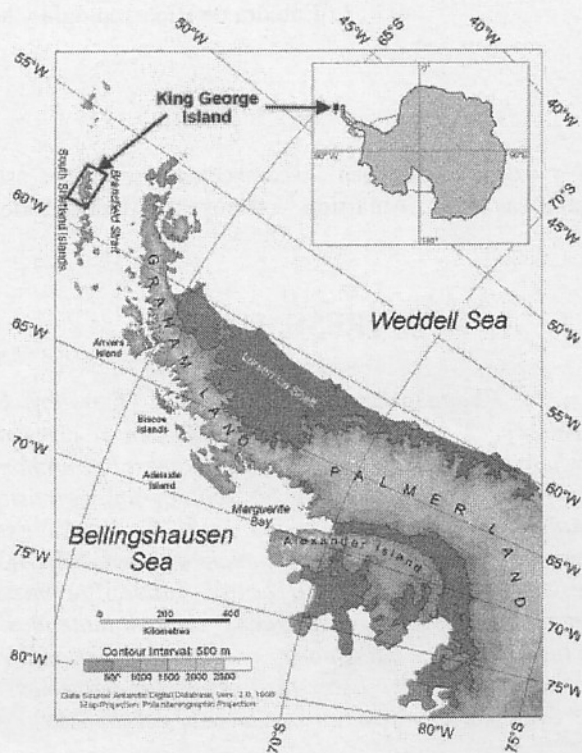


Fig. 1. Location of King George Island, Shetland South archipelago

## RESULTS

### *Phaeosphaeria microscopica* (Karsten) O.

Eriksson, Ark. Bot. 6:416.1967. Figs. 4, 5, 6

*Mycelium* septate, thin- to thick-walled, hyaline to pale brown, 1-5 µm wide; *ascomata* scattered, immersed, subepidermical, usually globose, sometimes lenticular or rarely pyriform, ostiolate, glabrous, pale to mid reddish-brown, translucent, 60-120 µm diam. when globose, 70-85 x 90-110 µm if lenticular, and 80 x 60 µm

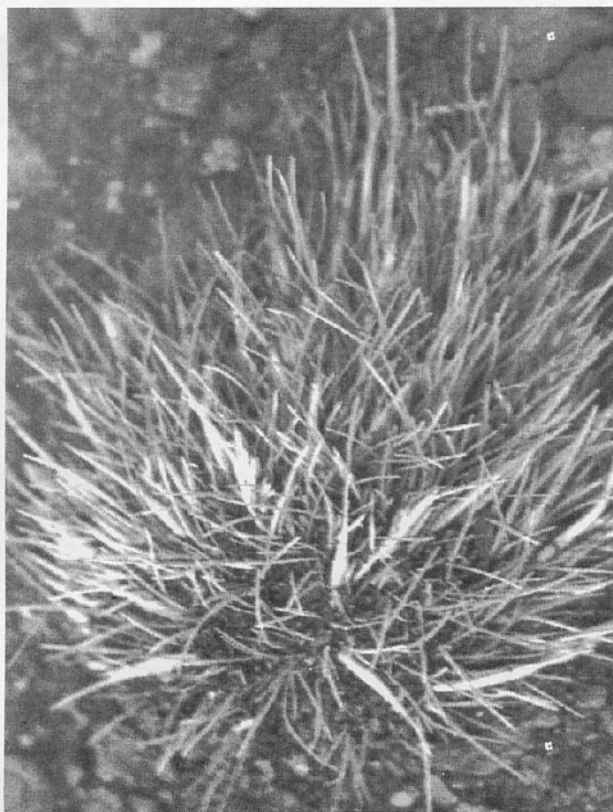


Fig. 2. *Deschampsia antarctica* Devs. specimen on the ground



Fig. 3. Comparative size of *D. antarctica*. The smaller squares correspond at 1 mm<sup>2</sup> area.

if pyriform, containing up to 10 asci; *ostiole* central, up to 40 µm wide, without periphyses, very rarely papillate; *beak* absent; *peridium* of *textura angularis*, pale to mid reddish brown, translucent, 1-2-layered, up to 10 µm thick, cells polygonal, pale reddish brown, 5-10 µm diam; *asci* not numerous, fasciculate in a basal cluster, fissitunicate, 8-spored, short-pedicellated (up to 5 µm long), cylindrical-clavate, without apical structures, 57-70 x 15-17 µm; *ascospores* broadly fusiform to navicular or clavate, L/W 3.0, straight or inequilateral, 20-21 x 7 µm, 3-septate in sequence 2:1:2, first septum slightly constricted, supramedian (0.47), constricted at other septa, without dots and the ends of septa, mid reddish brown, thick-walled, the 2<sup>nd</sup> cell broader than the rest, smooth-walled, without sheath.

*Material examined*: FMR 9000, Antarctica, South Shetland Islands, King George Island, Three Brothers Hill, on leaves of *Deschampsia antarctica* Desv., 10 Nov 1996, leg. by W. Mac Cormack, identified by A. M. Stchigel.

*Other hosts reported previously*: *Calamagostis pseudophragmites* (Haller fil.) Koeler; *Carex atrata* DC.; *C. nivalis* Boott.; *C. nubigena* D. Don.; *Deschampsia caespitosa* (L.) Beauv.; *Elymus nutans*

Briseb.; *Festuca ovina* L.; *F. rubra villosa* Spenner; *Pleuropogon sabinei* R. Br.; *Trisetum spicatum* (L.) Richt.

*Distribution*: Canada; arctic and alpine regions.

Sivanesan (1984) cited *Phaeoseptoria aireae* (Grove) Sprague as anamorph for *P. microscopica*, but it was not considered for our case.

## DISCUSSION

The genus *Phaeosphaeria* includes species that parasites member of **Poaceae** and other grass-like monocots plants. It causes serious crop diseases and it is very specialized to host, but some species has a large host spectrum. There exist two main revisions that could be consulted. The first one is a compendium on bitunicate ascomycetes (Sivanesan 1984), which included it into *Leptosphaeria* Ces. & de Not. The last monograph is due to Shoemaker and Babcock (1988), who divided it in 6 subgenera, and included keys for 117 accepted species; however, anamorph-teleomorph connections were not included here, as it occurs in the former work.

Our specimen differs from the description offered by Shoemaker and Babcock (1988) in having





Fig. 4. *Phaeosphaeria microscopica* FMR 9000. Broken ascoma, showing asci and ascospores.

smooth-walled ascospores, and results closest to *P. culmorum* (Auerswald ex Rehm) Leuchtman, considered by Sivanesan (1988) as their synonym. However, *P. microscopica* is reported only for alpine and arctic regions (Leuchtman, 1984), a comparable environment where the present specimen was collected. Then, based on these minor morphological differences between both taxa, we concluded that *P. culmorum* is co-specific with *P. microscopica*, and agree with Sivanesan (1984) in maintaining the synonymy as *P. microscopica*.

## REFERENCES

- Alberdi, M. & Corcuera, L.J. (1991). Cold acclimation in plants. *Phytochemistry* 30:3177-318
- Bravo, L.A.; Ulloa, N.; Zúñiga, G.E.; Casanova, A.; Corcuera L.J. & Alberdi, M. (2001). Cold resistance in Antarctic Angiosperms. *Physiol. Plant* 111:55-65
- Cabrera, A.L. (1994). *Regiones Fitogeográficas Argentinas. Enciclopedia Argentina de Agricultura y Jardinería. Tomo II, fascículo 1, primera reimpresión.* Acme ed., Buenos Aires.

Leuchtman, A. (1984). Über *Phaeosphaeria* Miyake und andere bitunicate Ascomyceten mit mehrfarch querseptierten Ascosporen. *Sydowia* 37:75-194



Fig. 5. *Phaeosphaeria microscopica* FMR 9000, asci and ascospores.

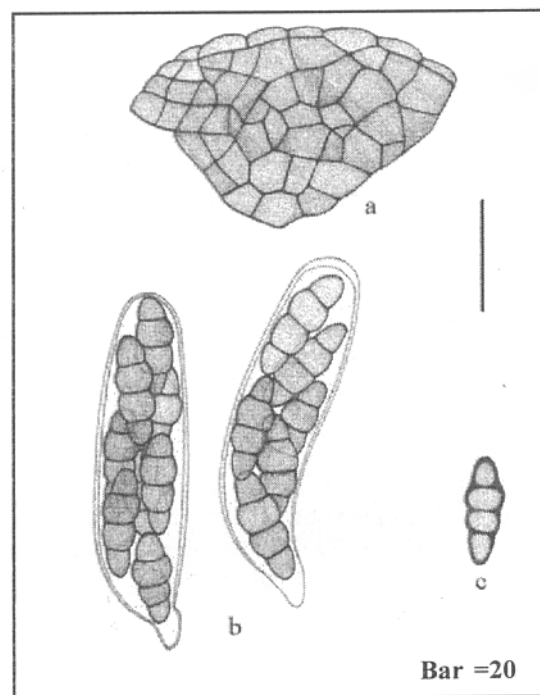


Fig. 6. *Phaeosphaeria microscopica* FMR 9000, a) detail of a peridial wall, b) asci within mature ascospores, c) ascospores

**Lindsay, D.C.** (1971). Vegetation of the South Shetland Islands. British Ant. Surv. Bull. 25:59-83

**Miyake, I.** (1909). Studies on parasitic fungi on rice in Japan. Bot. Mag. Tokyo 23:85-97

**Möller, C. & Dreyfuss, M.M.** (1996). Microfungi from Antarctic lichens, mosses and vascular plants. Mycologia 88: 922-933

**Shoemaker, R.A. & Babcock, C.E.** (1988). *Phaeosphaeria*. Can. J. Bot. 67:1500-1599

**Sivanesan, A.** (1983). *The bitunicate ascomycetes and their anamorphs*. J Cramer, Vaduz, Germany