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GLOMUS ANTARCTICUM SP. NOV., A VESICULAR-ARBUSCULAR MYCORRHIZAL FUNGUS FROM ANTARCTICA

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SUMMARY

The examination of soil samples collected on the rhizosphere of *Deschampsia antarctica* Dev. from Danco Coast, Antarctic Peninsula for vesicular arbuscular mycorrhizal (VAM) fungi revealed an undescribed species of *Glomus* which forms sporocarps and abundant soil-borne as well as intradical spores in pot cultures characterized by an evanescent outer wall, a laminated middle wall and a membranous inner wall.

Vesicular arbuscular are by far the most important and most widely distributed (geographically as well as within the plant kingdom) type of mycorrhiza.

They have been reported from all continents except Antarctica (Tinker, 1975). But during the "Campaña Antártica Argentina de verano 1989" undertaken by one of us (M.N. Cabello) the examination of rhizospheric soil of *Deschampsia antarctica* revealed that there are mycorrhiza in this Continent at least in Danco Coast, Base Primavera. The same locality is indicated in a map by Gamundí and Spinedi (1987).

Colobanthus quitensis Kunth (Caryophyllaceae) and *Deschampsia antarctica* Dev. (Gramineae) are the only two native phanerogams known from within the Antarctic botanical zone, as defined by Greene (1964).

The soil under *Deschampsia* was characterized as Cryosaprist (muck) genetically dependent on the Gramineae where it takes root (Leonardi et al., 1987). Its characteristics are: organic matter: 79,35%; mineral

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fraction: 2,80%; Total C: 46,02%; N: 3,40%; P: 306ppm; pH: 5,3.

Spores were extracted from rhizospheric soil samples by wet-sieving and decanting (Gerdemann and Nicolson, 1963). Roots were cleared and stained (Phillips and Hayman, 1970).

This study revealed that rhizospheric soil and roots of *Deschampsia* are positively colonized by VAM, whereas *Collobanthus* has not mycorrhiza.

Spore wall terminology follows that of Walker (1983) and descriptions are based upon the appearance of spores mounted in a polyvinyl/alcohol/glycerol/lactic acid solution (PVLG) (Koske and Tessier, 1983). Collections have been deposited in the Herbarium of the Spegazzini Institute (LPS).

SPECIES DESCRIPTION

***GLOMUS ANTARCTICUM* Cabello sp. nov. Fig.1-6.**

Sporocarpia sine peridio, globosa vel subglobosa, 1000 x 564 um diam., chlamydosporae in sporocarpis per mycelium glomerulatae. *Chlamydosporae* fulvae vel fuscae, globosae, subglobosae, ovoideae vel irregulares, 50 x 75 um diam. *Sporae* tunica 3-12um crassa, stratis tribus: exteriori 2 um crassa, hyalino, ephemera; medio 4-8 um crasso, lutea vel brunnea ex laminosa, strato exteriori separabili, interiori 1,5-2 um crasso. *Sporae* ad hyphae subtendentes affixae, tunica exteriori breven partem hyphae proximam includente, et interiori per spatium 20 um in hypha extensa et eam incrassante. *Sporarum* contentus primo ab hypha a septo tenui separatus, maturarum a lamina interiori incrassata.

HOLOTYPUS: Antarctica, Peninsula Antarctica, Terra de Danco, Base Primavera, Leg. M.N. Cabello, I-1989, LPS 45265

Sporocarps without peridium, globose or subglobose 1000 x 564 um diam.; sporocarps formed by interwoven hyaline hyphae, hyphae 3-5,5 um in diam. with 0,1-0,5 um thick walls; the surface of the sporocarps is knobby due to the appearance of spores.

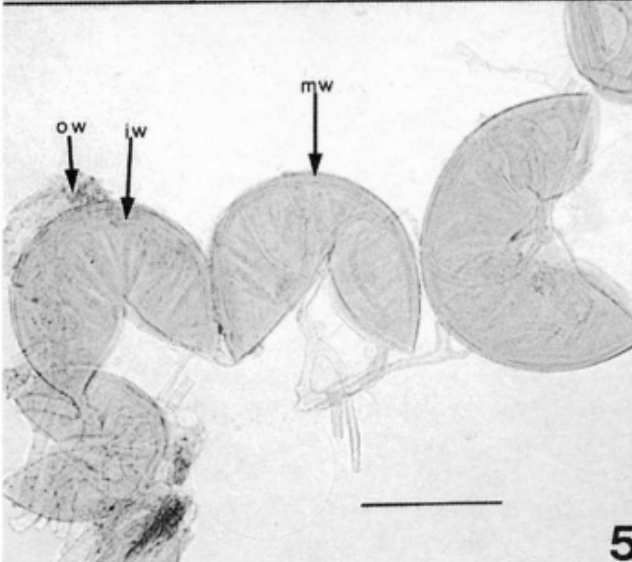
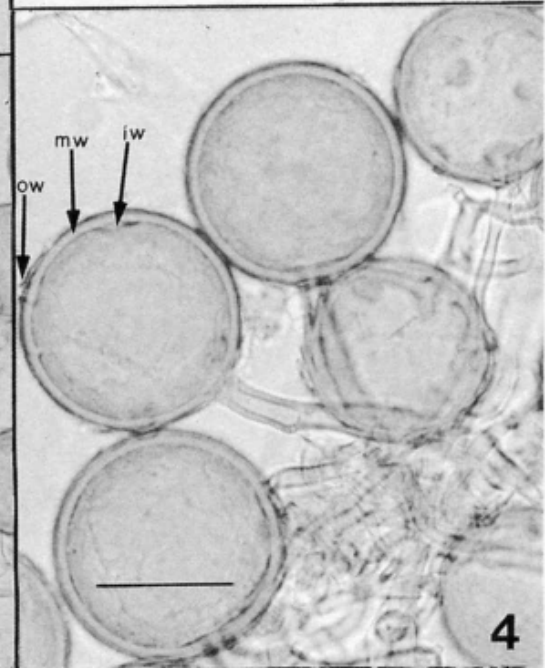
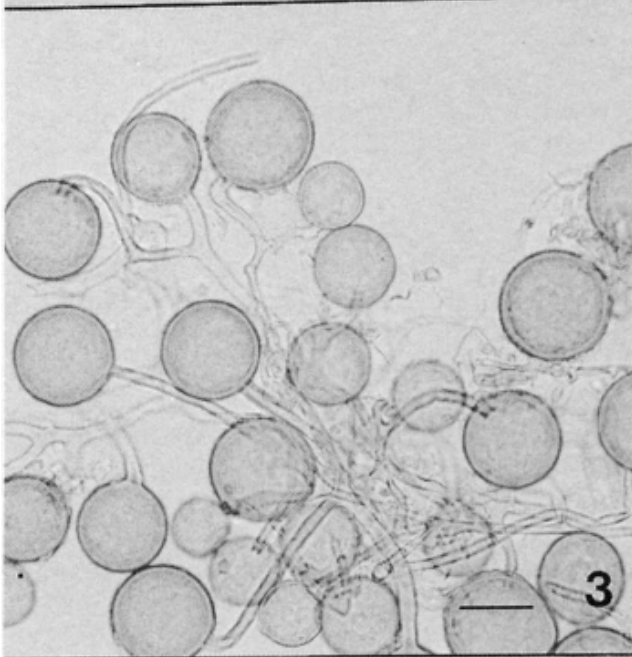
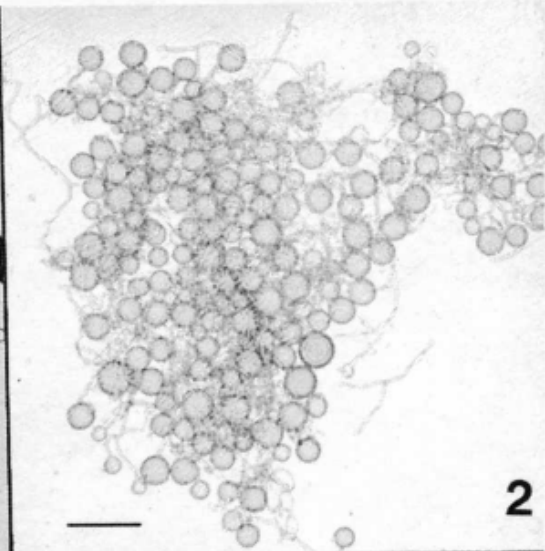
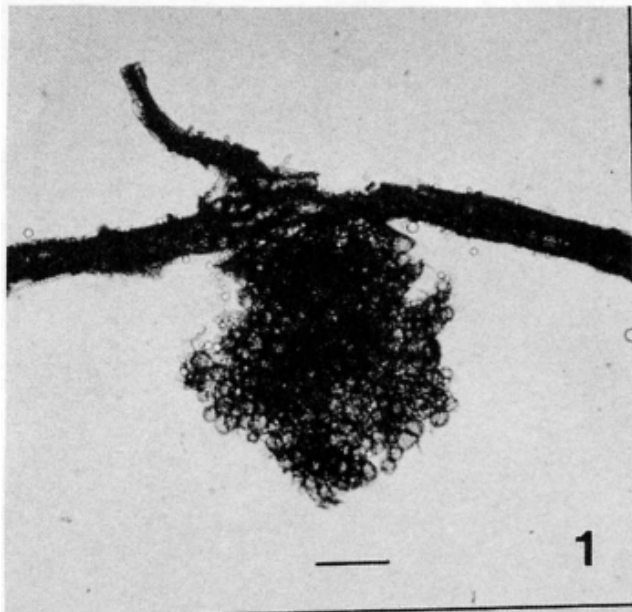
Chlamydo spores yellow to brown, globose to subglobose, occasionally ovoid or irregular, 50-70 um diam.

Spore wall structure 3-12 um consisting of three walls; the outer wall 2 um thick, ephemeral, hyaline; the middle layer 4-8 um thick, light brown, laminated; inner wall hyaline, 1,5-2 um thick.

Figure 1-6 *Glomus antarcticum* sp. nov.

1. Sporocarp attached to a piece of root.
- 2 & 3. Cluster of chlamydo spores.
4. Mature chlamydo spores; ow: outer wall, mw: middle wall, iw: inner wal.
5. Mature broken chlamydo spores.
6. Sporulation in the root cortex of *Medicago sativa* in pot culture.

Bars represent 300 um in 1; 100 um in 2 & 6; 50 um in 3, 4 & 5.



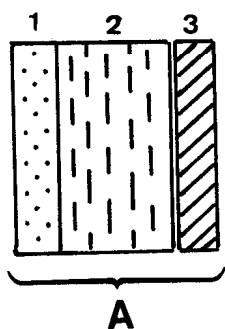
Spore with a hyphal attachment. Outer wall extending down the attached hypha thickened by the extension of the inner spore wall for up to 20 μm .

Spore contents separated from the attached hypha by a thin septum; at maturity, the opening occluded by inner wall thickening.

Collection examined: Holotype, Antarctic Peninsula, Danco Coast, Cierva Cove, Base Primavera, leg. M.N. Cabello, I-1989, LPS 45265.

Paratype, originating from the rhizosphere of Medicago sativa L. LPS culture N° 81.

Murograph of Glomus antarcticum



Arabic numerals indicate each wall in order from outer to inner wall. Wall 1 is evanescent, wall 2 is laminated, wall 3 is membranous; the letter A indicates a wall grouping.

Distribution and habitat: Glomus antarcticum has been found in rhizospheric soil of Deschampsia antarctica at Danco Coast, Base Primavera, Antarctic Peninsula.

Mycorrhizal associations: forming vesicular-arbuscular mycorrhiza with alfalfa (Medicago sativa L) and sorghum (Sorghum vulgare Pers.) in pot cultures whose spore or root material is used as inoculum. Associated in the field with roots of Deschampsia antarctica.

DISCUSSION

Our description of Glomus antarcticum sp. nov. shows that it is closely related in size and shape to G. fuegianum (Spegazzini) Trappe & Gerdemann and G. fasciculatum (Taxter sensu Gerdemann) Gerdemann & Trappe. However, this new species has some characteristics that distinguish it from them. The sporocarps of G. antarcticum differ from G. fuegianum in the lack of peridium and in the chlamydospores that never arise from a vesicle supported by a broad sporophore. On the other hand, G. antarcticum spores revealed negative reaction to Melzer's reagent and they have the outer unit wall evanescent while G. fasciculatum spores have an inner wall that turns red in

Melzer's reagent and the outer wall is not evanescent (Walker and Koske, 1987).

An other significant character that is used in identification of species of *Glomus* is the presence of a septum that occludes the lumen of the spore. In *G. antarcticum* this septum is constituted by the thickening of the inner wall of the subtending hypha at maturity; in *G. fuegianum* the amorphous material of the septum appears to be derived from modified cytoplasm (Yao et al., 1992) and in *G. fasciculatum* the spores are never occluded by a septum.

This study revealed the presence of a new species of *Glomus* which was isolated from rhizospheric soil of the only grass which grows in Antarctica: *Deschampsia antarctica*. This recovering in the Antarctic area answers the question made by Christie and Nicolson (1983) about if mycorrhizas were absent from the Antarctic. These authors have reported that mycorrhizas were not present in several places of Antarctic Peninsula included Spring Point. On the other hand, Stubblefield et al. (1987) found a fossil endogonaceous fungus that remembered them to *Sclerocystis*, in a silified matrix from the Triassic of Antarctica.

In field conditions a low number of spores and some colonized *Deschampsia* roots were found. By means of the pot culturing method active VAM fungal propagules were found in rhizospheric soil of *Deschampsia*. In this way *Glomus antarcticum* was isolated at the Spegazzini Institute.

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REFERENCES

- CHRISTIE, P. & T.H. NICOLSON. 1983. Are mycorrhizas absent from the Antarctic?. *Trans. Br. Mycol. Soc.* 80 (3): 57-560.
- GAMUNDI, I.J. & H.A. SPINEDI. 1987. *Sclerotinia antarctica* sp. nov. The Teleomorph of the first fungus described from Antarctica. *Mycotaxon* 29: 81-89.
- GERDEMANN, J. W. & T. H. NICOLSON. 1963. Spores of mycorrhizal *Endogone* species extracted from soil by wet sieving and decanting. *Trans. Br. Mycol. Soc.* 46 (2): 235-244
- GREENE, S. W. 1964. Plants of the Land. In *Antarctic Research*. Ed. PRIESTLEY, R. E.; R. J. ADIE & G. DE Q. ROBIN. London, Butterworth and Co. (Publ.) Ltd. 240-253.

- KOSKE, R. E. & B. TESSIER. 1983. A convenient, permanent slide mounting medium. Mycol. Soc. Am. Newsletter 34: 59.
- LEONARDI, J. M.; C. MARCHETTI; L. MONTICELLI & M. OSTERRIETH. 1987. Caracterización preliminar de un Histosol Antártico bajo gramíneas. Contribución N° 340 del Instituto Antártico Argentino, Buenos Aires.
- PHILLIPS, J.M. & D.S. HAYMAN. 1970. Improved procedures for clearing roots and staining parasitic and VA mycorrhizal fungi for rapid assessment of infection. Trans. Br. Mycol. Soc. 55 (1): 158-161.*-
- STUBBLEFIELD, S. P.; T. N. TAYLOR & R.L. SEYMOUR. 1987. A possible endogonaceous fungus from the Triassic of Antarctica. Mycologia 79 (6): 905-906.
- TINKER, P. B. H. 1975. Effects of vesicular-arbuscular mycorrhizas on higher plants. Symposia of the Society for Experimental Biology N° 29. Symbiosis 325-349.
- WALKER, C. 1983. Taxonomic concepts in the Endogonaceae: spore wall characteristics in species descriptions. Mycotaxon 18: 443-455.
- WALKER, C & R. E. KOSKE. 1987. Taxonomic concepts in the Endogonaceae: IV. Glomus fasciculatum redescribed. Mycotaxon 30: 253-262.
- YAO, Y. J.; D. N. PEGLER & T. W. K. YOUNG. 1992. Ultrastructure of Glomus fuegianum. The Mycologist 6 (3): 132-137