

GLOMUS STERILUM, A NEW SPECIES OF VA-MYCORRHIZA ISOLATED FROM POTATO ROOTS

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ABSTRACT

A new species of vesicular-arbuscular mycorrhiza, Glomus sterilum was isolated from the roots of potato plant. Spores are pale yellow, orange brown to reddish brown with one or two wall layers in a single wall group. The outer wall layer is a brittle unit layer, yellow to reddish brown in color and the inner, when present, is a yellow to yellow brown membranous layer which often collapses in hypertonic solutions. Besides the information of fertile sporocarps this fungus also produces well-defined sterile sporocarps with a distinct pseudoparenchymatous peridium but without the presence of chlamydo spores within them. These sterile sporocarps are globose to subglobose and their colour changes from hyaline to brown with age. The fungus form vesicular-arbuscular mycorrhizae with maize, sunflower and bahia grass but no vesicles are produced in potato.

INTRODUCTION

During the course of taxonomic studies of the VA mycorrhizal species associated with agricultural crops, an isolate was found to be new. A detailed study of the species was made and it was found to differ in certain characters from the species of *Glomus* reported so far.

MATERIALS AND METHODS

Potato plants growing in a garden were carefully pulled out and after thoroughly washing the roots under running water and subsequently sterilizing them in sodium hypochlorite solution (20%) for 5 minutes followed by four changes of sterilized water, the plants were replanted in pots containing sterilized soil. After about 90 days, the mycorrhizal spores were extracted by wet sieving and decanting method¹ and were multiplied on maize plants by single spore pot culture technique. Spores were collected from these pots and specimens were mounted on microscopic slides in Polyvinyl Lactophenol (PVL)² for observations. In identifying the isolate the key to the species prepared by Trappe³ and Schenck and Perez⁴ were consulted for preliminary identification and then were compared for structural details with the information available in the original species descriptions. Depicting wall structure guidelines given by Walker^{5,6} and Morton⁷ has been adopted in describing wall characteristics and micrograph. The proposal of Berch⁸ to distinguish "wall layers" instead of "walls" within a composite spore wall has been accepted here.

RESULTS

Glomus sterilum sp.nov. (Fig. 1 Plate I & II)

Sporocarps hypogaeum, variable in size, 256-576 X 320-640 μm , pale yellow, yellow brown to orange brown in transmitted light with peridium composed of loose mass of hyphae. Chlamydospores within the sporocarps mostly thin-walled and irregular in shape. Chlamydospores formed singly in soil, terminal to subterminal, pale yellow, orange brown to reddish brown, globose (39.6)136.8 (-144.0) μm , subglobose to irregular. Composite spore wall one to two layered (1 & 2) in a single wall group, 7.2-10.8 μm thick. Wall layer 1 consists of a single brittle unit layer, yellow to reddish brown, 3.6-5.4 μm thick, except at the spore base where it may be greatly thickened. Wall layer 2, when present, membranous, yellow to yellow brown, 1.8-2.7 μm thick. Subtending hypha, straight to infundibuliform, 7.2-25.2 μm wide at the spore base with pore closed by means of a septum formed by the inner spore wall layer, sometimes distending into the hyphal attachments. Besides fertile sporocarps, sterile sporocarps also characteristically formed, when young 154.8-180.0 μm in diam, with peridium consisting of a loose mass of interwoven hyphae. On maturity up to 288.0 μm in diam and with pseudoparenchymatous peridium. Often two hyphae attached to the sterile sporocarps present. Forming vesicular-arbuscular mycorrhizae.

ETYMOLOGY : Latin, *sterilis* (sterile), referring to the sterile sporocarps produced by this fungus. The species epithet is given neuter ending "um" as has been proposed by Schenck and Smith⁹.

TYPE : The holotype specimen is deposited in the BSM culture collection, Department of Botany, Allahabad University, Allahabad, India, Culture No. SS-12 on *Zea mays*. Propagated on *Zea mays* in pot culture.

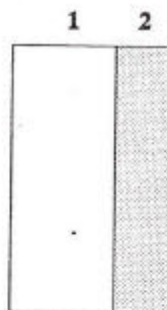
DISTRIBUTION : *Glomus sterilum* was found in association with plants of potato (*Solanum tuberosum* L.) grown in a garden. It formed vesicular-arbuscular mycorrhiza with maize (*Zea mays* L.) bahia grass (*Cenchrus ciliaris*) and sunflower (*Helianthus annuus* L.) grown in pot culture. Chemical properties of the soil were : pH-7.5; extractable P_2O_5 (kg/ha)-13.7; extractable K_2O (kg/ha)-201.0; organic carbon-0.69%; soil texture : loamy-sand.

DISCUSSION

This species of *Glomus* comes close to *G. microaggregatum* Koske, Geema & Olexia, *G. formosanum* Wu & Chen and *G. aggregatum* (Schenck & Smith) Koske. But it differs from *G. microaggregatum* in having larger spores with wider subtending hypha and thicker spore wall layers besides the presence of sporocarps. From *G. formosanum* it differs in having larger spores and a thinner composite spore wall. From *G. aggregatum* it can be differentiated by its larger spores, presence of peridium in sporocarps, by its thicker subtending hyphae, and its spores having a unit and a membranous wall layers instead of two laminated layers.

Besides fertile sporocarps (containing chlamydospores) distinct sporocarp-like structure (sterile sporocarps) with well developed pseudoparenchymatous peridium are produced by this fungus. The sterile sporocarps changes their colour from hyaline to yellow and ultimately become brown with age. The object of forming such compact sterile sporocarps by this fungus may be due to the fact that both the fertile and sterile sporocarps are asexual bodies. In the former the chlamydospores and in the latter the sporocarp itself, acts as senescent bodies for rejuvenation of the fungus in future. Occasionally the chlamydospores and sterile sporocarps give rise to hyaline to yellow "vesiculate swellings" on their surface which generally collapse in hypertonic solution. These "vesiculate swellings" show thickened walls and at times possess long hyphal attachments and a septum at the point of hyphal attachment to the spore. They may also possess two walls, which can be distinguished in mature "vesiculate swellings" in squash mounts. Such vesiculate swellings were first reported by Koske and Walker¹⁰ in *G. globiferum*, who proposed that these could perhaps be called "secondary spores".

The sterile sporocarps reported in this new species have also been found in few species of *Mortierella* viz., *Mortierella pseudozygospora* W. Gams & Carreiro with chlamydospores enveloped in masses of short hyphal branches, *M. sterilis* B. S. Mehrotra and B. R. Mehrotra and *M. alpina* Peyronel with well developed sterile pseudoparenchymatous masses of hyphae, since *Glomus* is phylogenetically related to *Mortierella*, the two used to be placed in the same order Mucorales, in the past. The present isolate is possibly of evolutionary significance.



Micrograph of the wall structure of *G. sterilum*. Myronym is A(UM).

ACKNOWLEDGEMENTS

I wish to thank Dr. B. S. Mehrotra, Retd. Professor of Botany, Allahabad University, for his valuable suggestions from time to time. I am grateful to Dr. N. C. Schenck for inspiring me to take up taxonomic work on Endogonaceae. I am also grateful to Dr. C. Walker for explaining the wall types during his visit to India. This study forms a part of the studies initiated by the first author as Dr. K. S. Krishnan Research Fellow of the Department of Atomic Energy, Government of India, an award gratefully acknowledged.

REFERENCES

- ¹Gerdemann, J. W. & Nicolson, T. H. (1963), *Trans. Brit. Mycol. Soc.* 46 : 235-244.
- ²Koske, R. E. & Tessier, B. (1983). *Mycological Society of America Newsletter.* 34 : 59.
- ³Trappe, J.M. (1982). *Pytopathology.* 72 : 1103-1108.
- ⁴Schenck, N.C. & Perez, Yonne (1988). *Manual for the identification of VA mycorrhizal fungi*, II ed. pp. 63.
- ⁵Walker, C. (1983). *Mycotaxon*, 18 : 443-455.
- ⁶Walker, C. (1986). *Mycotaxon*, 25 : 95-99.
- ⁷Morton, J.B. (1986). *Mycologia*, 78 : 641-648.
- ⁸Berch, S.M. (1987). *Endogonace: Taxonomy, specifically, fossil record, phylogeny.* In "Frontiers of applied microbiology". Vol. II. ed. Editors Mukherji, K. G., Singh, Ved Pal and Garg, K. L. Print House, India pp. 161-188.
- ⁹Schenck, N.C. & Smith, G.S. (1982). *Mycologia*, 74 : 77-92.
- ¹⁰Koske, R. E. & Walker, C. (1986). *Mycotaxon* 26 : 133-142.

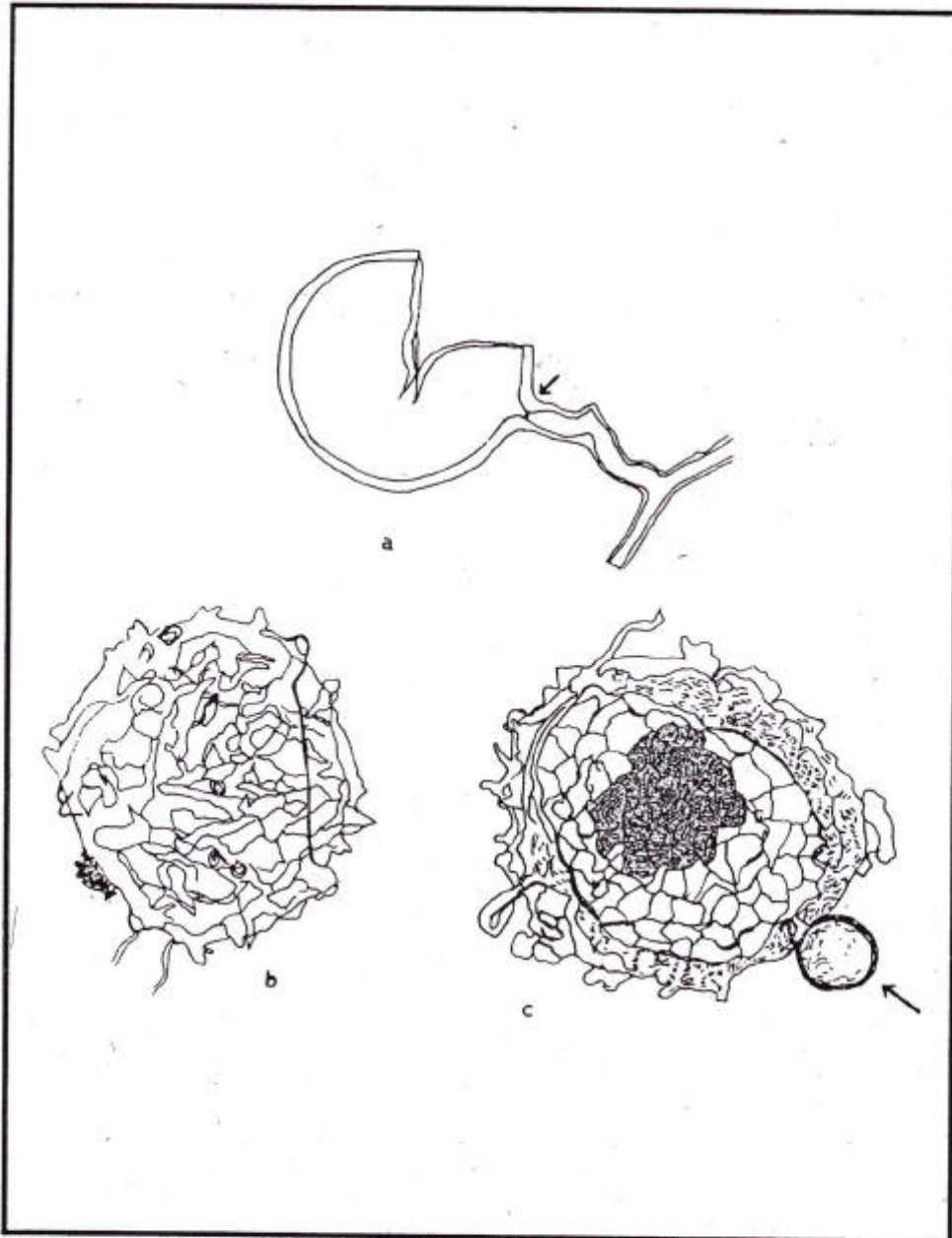


Figure 1. (a-c) Camera lucida drawings of *Glomus sterilum*

(a) A chlamydospore with a septum (indicated by an arrow) formed in the subtending hypha by the inner spore wall at a short distance from the point of attachment X 210.

(b) A young sterile sporocarp with two hyphal attachments X 330.

(c) A young sterile sporocarp with more compact peridium. Note the 'vesiculate swelling' (arrow), produced at times, over its surface X 330.

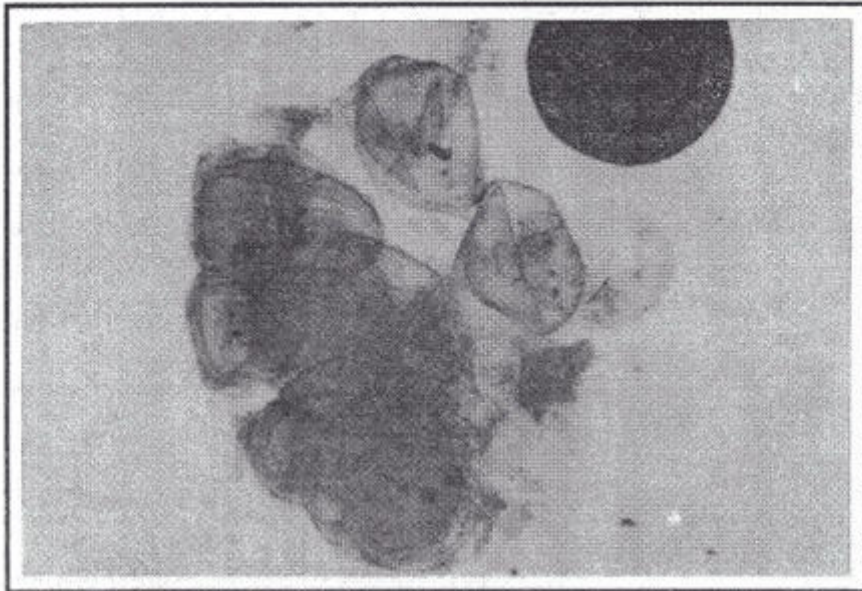


Figure 2. *Glomus sterilum*; A sporocarp X 80

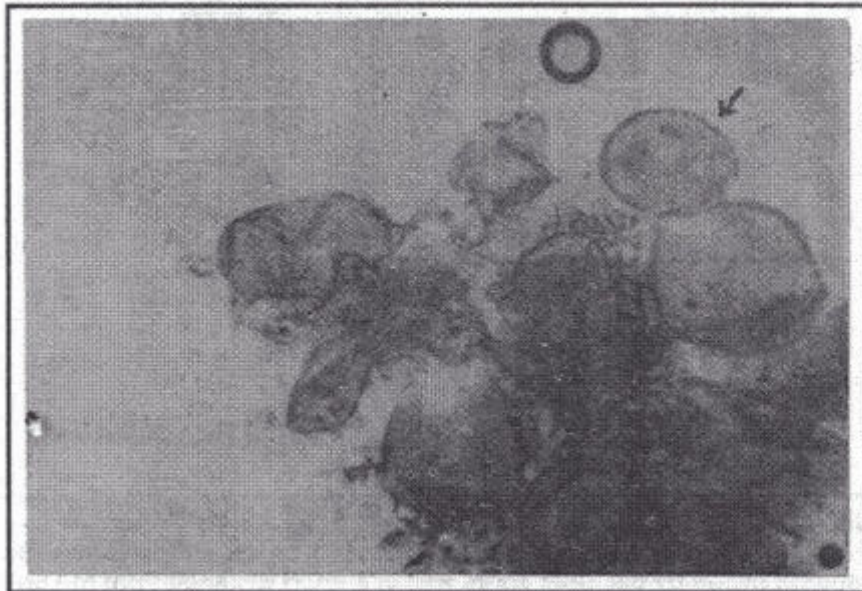


Figure 3. *Glomus sterilum*; Part of a sporocarp with globose to irregular-shaped spores X 100.

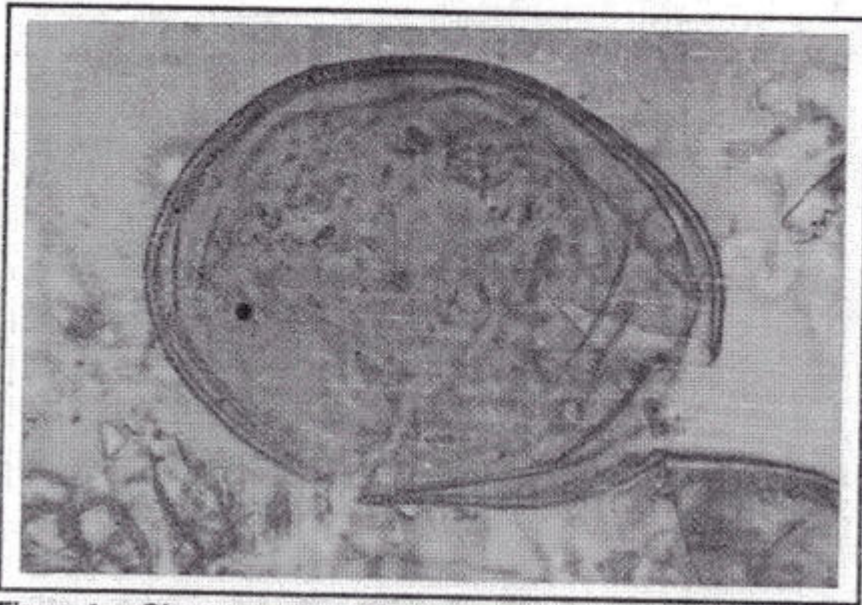


Figure 4. *Glomus sterilum*; A spore from a sporocarp (indicated by an arrow in Fig. 1), enlarged to show the two wall layers X 320.

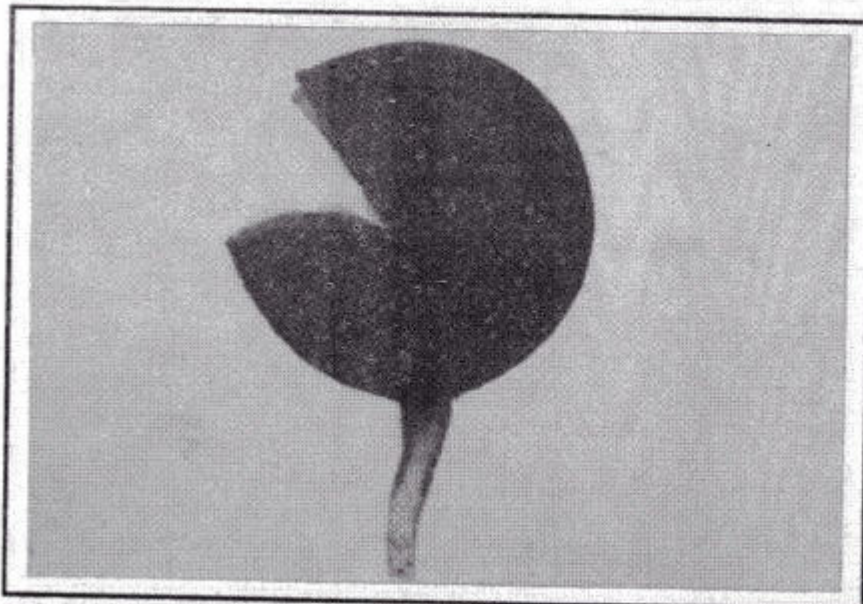


Figure 5. *Glomus sterilum*; A mature spore with two wall layers X 100

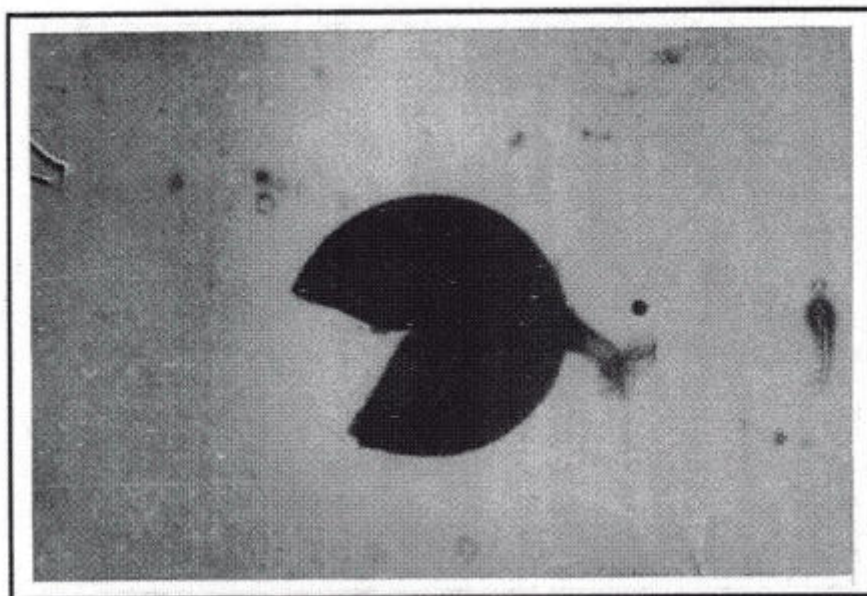


Figure 6. *Glomus sterilum*; Another mature spore with two wall layers and bifurcated hyphal attachment X 80.

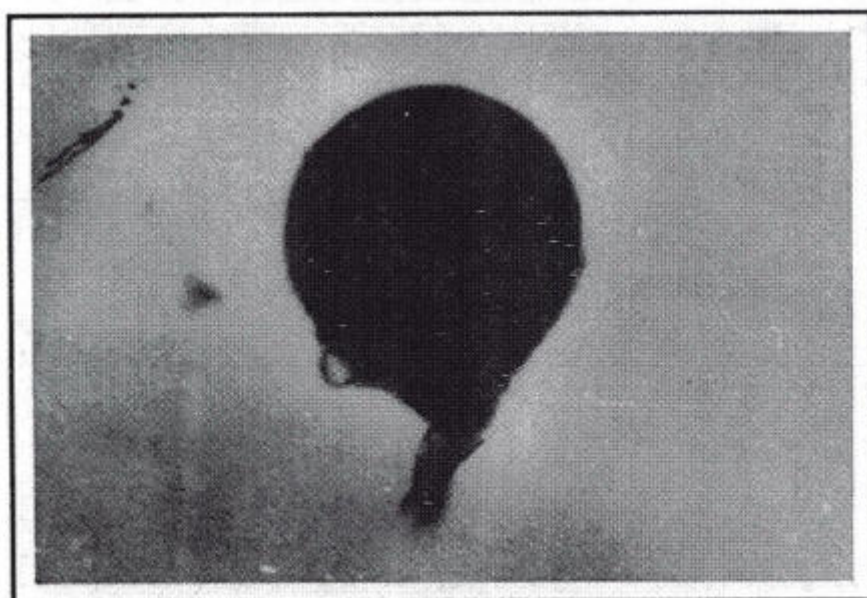


Figure 7. *Glomus sterilum*; A spore with a "vesiculate swelling" attached to its surface X 80.

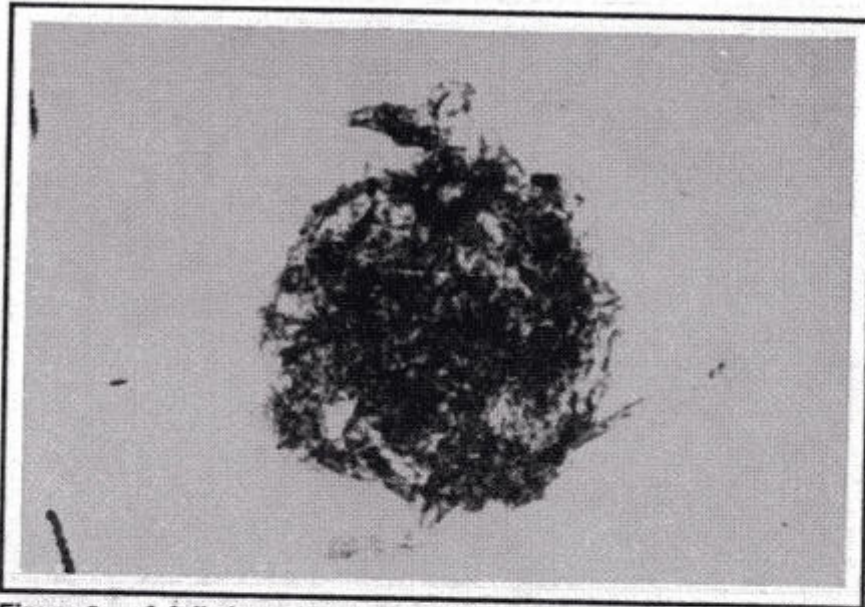


Figure 8. A full view of a young sterile sporocarp X 60

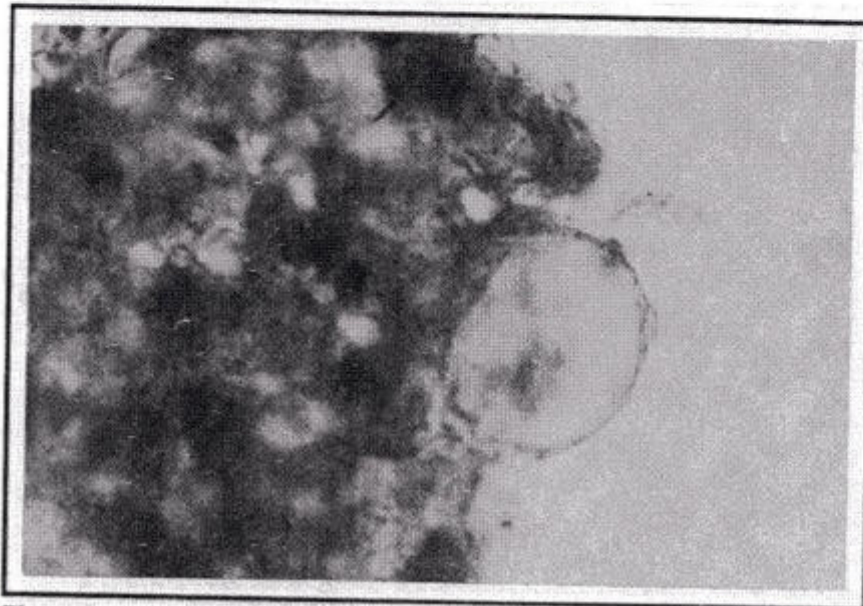


Figure 9. An inflated "Vesiculate swelling" attached to the sterile sporocarp X 320.

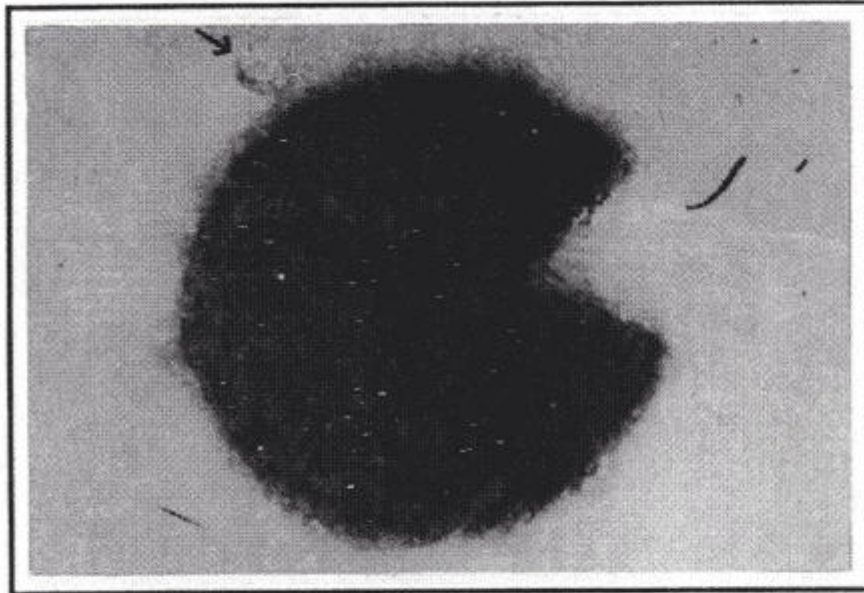


Figure 10. A sterile sporocarp with a prosenchymatous peridium. Note the vesiculate swelling (indicated by an arrow) X 160.

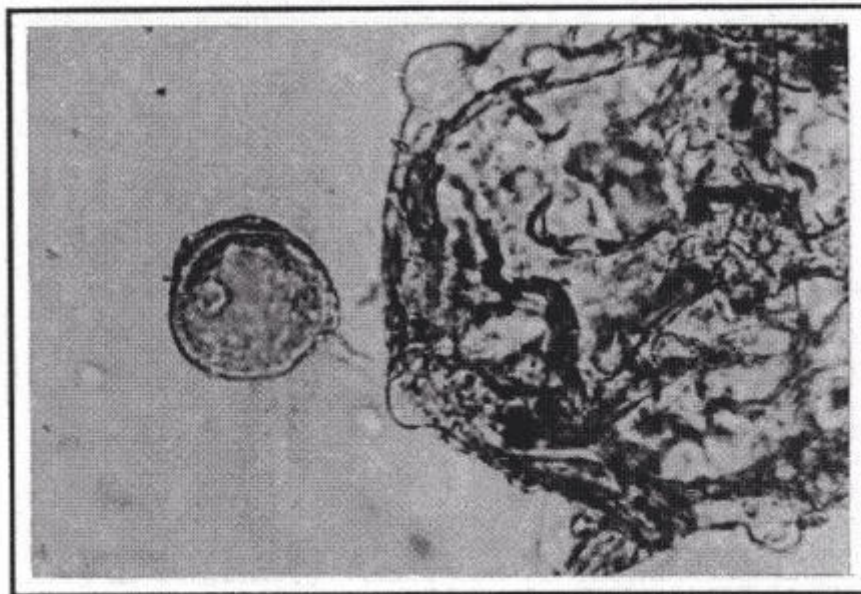


Figure 11. A "vesiculate swelling" attached to a sterile sporocarp with a hypha X 280.

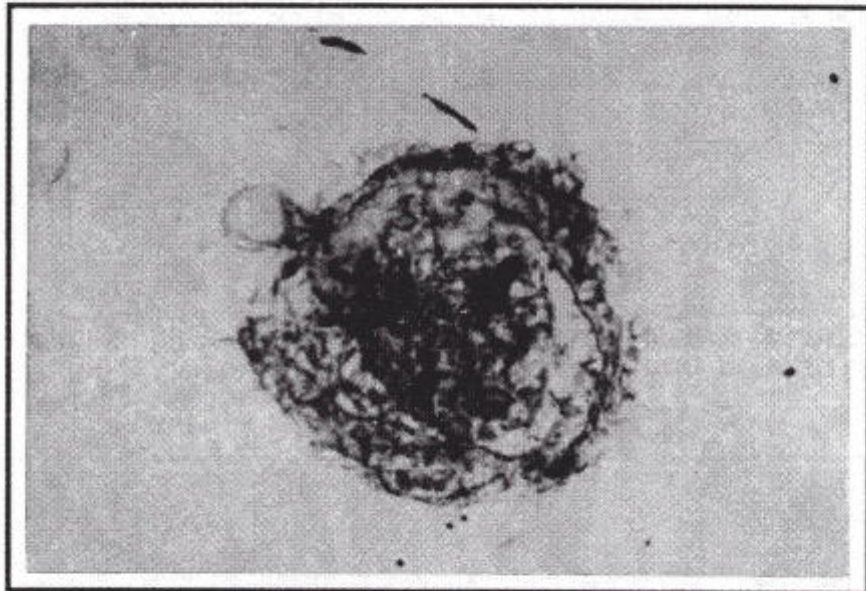


Figure 14. A view of an intact sterile sporocarp and an inflated "vesiculate swelling" X 100.