NEW SPECIES OF VESICULAR-ARBUSCULAR MYCORRHIZAL FUNGI

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Two new species of VAM fungi, *Glomus delhiense* and *G. multisubstensum*, are described from India.

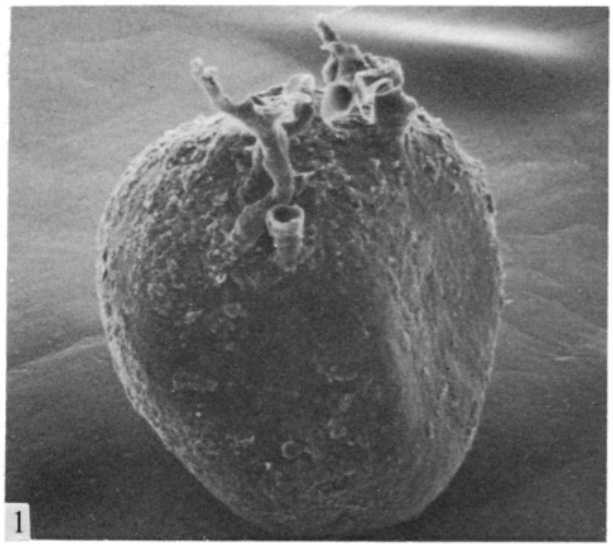
Since vesicular-arbuscular mycorrhizal (VAM) fungi may vary considerably in their reaction to different plant and soil conditions, their proper application to further plant productivity will require that they be taxonomically characterized (Trappe, 1982). The discussion on 'Future Directions and Priorities in Mycorrhizal Research' during the 1982 Annual Meeting of the American Phytopathological Society held at Salt Lake City, Utah also recognized taxonomic characterization of the VAM fungi as one of the priority objectives. This is one of a series of communications to further this goal and reports two new species of *Glomus* Tul. & Tul. Both were isolated by the wet-sieving and decanting method (Gerdemann & Nicolson, 1963) from soils collected from the Old Delhi Ridge, Delhi, India which is a natural forest stand.

The spores were studied by light and scanning electron microscopy (SEM). For SEM the air-dried spores were vapour-fixed with osmium tetroxide, mounted on stubs with conductive carbon paint, coated with gold and examined in a Cambridge Stereoscan 150 SEM.

Glomus multisubstensum sp.nov. (Figs 1–4)

Chlamydosporae singulatim vel in solo vel in glomeraminibus densis, 5–8 sporas continentibus, efformatae, globosae, pallide brunneae, 100–150 μm diam, tunica sporarum 10–15 μm crassa, duabus stratis inseparabilibus consistans; tunica externa 10–12 μm crassa, brunnea; tunica interna 1–4 μm crassa, pallide luteo-brunnea. Hyphae sustinentes 2–4 numero, in termino altero sporae colligatae, hyalinae, pallide flavae, tenuitunicatae, prope locum colligationis 10–15 μm crassae, deinde ad 5–7 μm fastigatae, septum aliquando praesens, 20–25 μm secundum hyphas sustinentes nonnumquam ramosas.

Chlamydospores formed singly in the soil or in compact clusters of 5 to 8 spores, globose, light brown, 100–150 μm diam; spore wall 10–15 μm thick, with two inseparable layers; outer layer 10–12 μm thick, brown; inner layer 1–4 μm thick and pale yellow brown. *Subtending hyphae* 2 to 4 in number, attached at one end of the spore, hyaline,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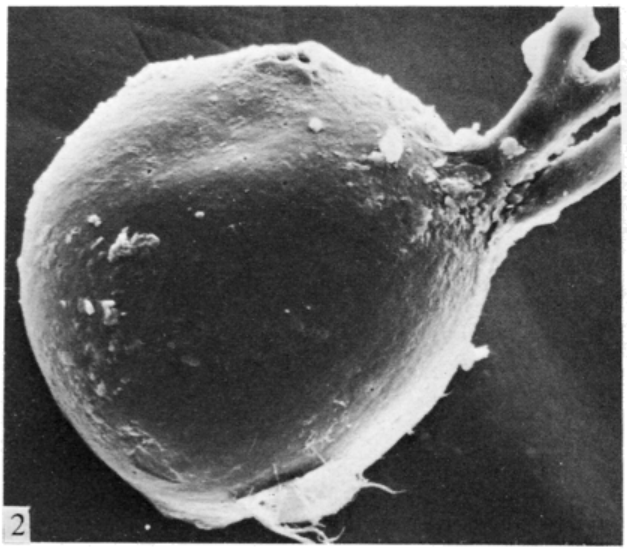
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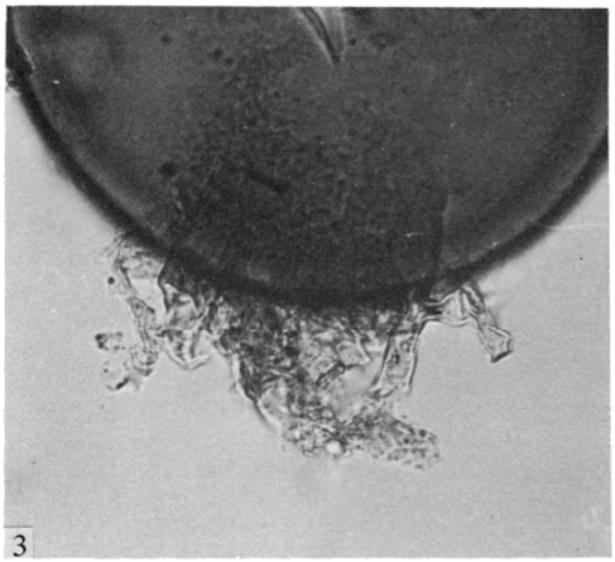
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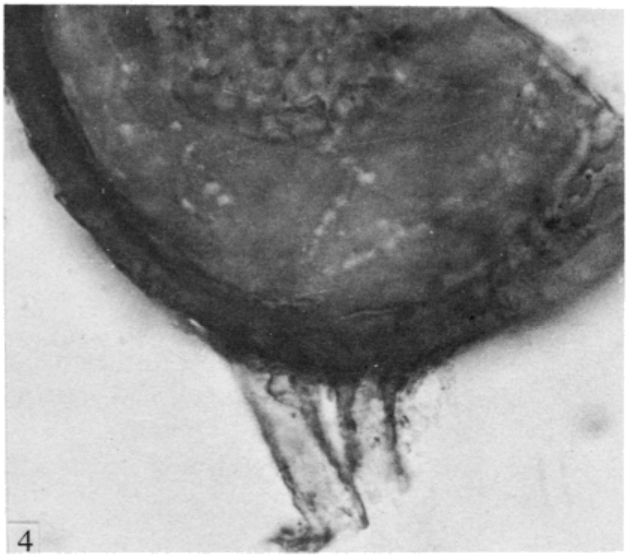
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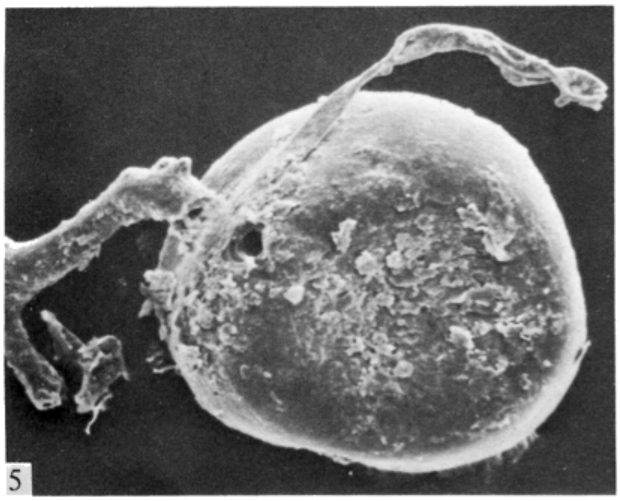
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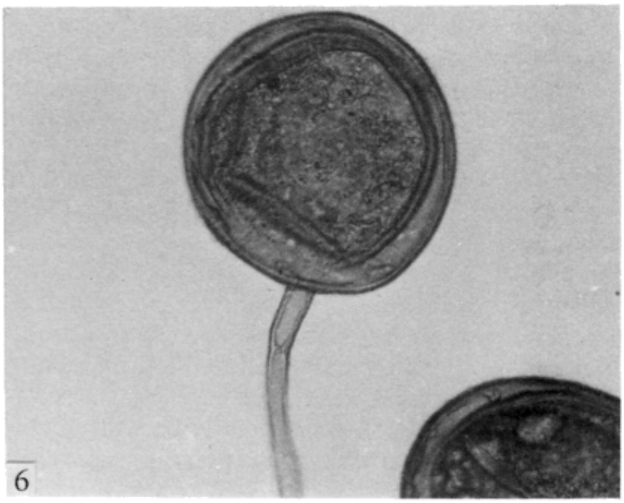
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Figs 1–4. *Glomus multisubstensum*. Figs 1, 2 SEM; Figs 3, 4 light micrographs. Chlamydospores with multiple hyphal attachment at one end of the spore. 1 × 450; 2 × 600; 3, 4 × 550.

Figs 5–6. *Glomus delhiense*. Figs. 5 SEM; Fig. 6 light micrograph. Chlamydospores with single hyphal attachment. In Fig. 5 the subtending hypha is broken off revealing the point of attachment. 5 × 550; 6 × 300.

pale-yellow, thin walled, 10–15 μm wide at the point of attachment, tapering to 5–7 μm width, septum present in some cases, 20–25 μm along the subtending hyphae which may be branched.

This species was consistently isolated from Old Delhi Ridge soil from near the roots of *Maerua arenaria* H. f. & T. (Capparidaceae). It was very abundant in February 1980 but declined in numbers during the summer months. Experimentally this species formed VAM with *Zea mays* L. in pot cultures. The holotype specimen is deposited in the Mycological Herbarium of the University of Delhi as DU/KMB 500.

Two species of *Glomus* (*G. multicaule* Gerdem. & Bakshi and *G. lacteum* Rose & Trappe) have spores sometimes with 3 or more subtending hyphae (Trappe, 1982). *Glomus multisubstensum* is clearly distinguishable from *G. multicaule* (Gerdemann & Bakshi, 1976) in having globose, smooth-walled spores, with multiple hyphal attachments being always present on one end of the spore. It can be distinguished from *G. lacteum* (Rose & Trappe, 1980) in having light brown spores with two wall layers.

Attempts were made to study the development of the spores, but it was not possible to determine whether the spores were zygosporic or chlamydosporic. Until the life cycle is established it would be best to assign it to the genus *Glomus*.

Many spores of *G. multisubstensum* revealed signs of hyperparasitism. In surface views perforations in the cell wall were seen (Fig. 2), while in the sectional views transverse fissures were seen. In these respects the mode of hyperparasitism appeared to be similar to that described for *Gigaspora candida* Bhattacharjee, Mukerji, Tewari & Skoropad (Bhattacharjee *et al.*, 1982).

Glomus delhiense sp.nov. (Figs 5, 6)

Chlamydosporae libere in conglomerationibus raris in solo natae, globosae, 100–125 μm crassae, tunica sporarum duplex; tunica externa 5–7 μm crassa, luteo-brunnea, cum laminis et leviter asperata; tunica interna 5 μm crassa, hyalina, hyphae sustinentes simplices usque ad 15 μm crassae prope locum colligationis, tunica transversa praesens vel in foramine ipso vel 25–30 μm secundum hyphas sustinentes. Cytoplasma granulare.

Chlamydospores borne freely in loose aggregates in the soil, globose, 100–125 μm; spore wall double; outer layer 5–7 μm, yellowish brown, laminate and slightly roughened; inner layer 5 μm, hyaline. *Subtending hyphae* simple, up to 15 μm wide at the point of attachment, with a cross wall present either at the pore itself or 25–30 μm along the subtending hypha. Cytoplasm granular.

This species was isolated during February to July 1980 from soil from a grassy area in the Old Delhi Ridge. In pot cultures it formed VAM with *Trigonella foenum-graecum* L. (Leguminosae). The holotype specimen is deposited in the Mycological Herbarium of the University of Delhi as DU/KMB 499.

In the genus *Glomus*, only one species (*G. magnicaule* Hall) is known to possess spores with outer brown and inner hyaline wall layers (Trappe, 1982). Thickness of the outer spore wall layer and that of the subtending hypha clearly distinguish *G. delhiense* from *G. magnicaule* (Hall, 1977). According to Hall & Fish (1979), *G. delhiense* keys out to Type 8 but differs in having a simple, instead of an infundibuliform, hyphal attachment (Sward *et al.*, 1978).

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