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Species diversity of *Glomus* in the rhizosphere of Sunflower

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Seven species of *Glomus* are studied on the basis of the morphological characters. The spores were extracted from the rhizosphere of Sunflower (*Helianthus annuus*), a common ornamental annual herb belonging to family Asteraceae. It is also cultivated as a crop for the extraction of edible oil from its seeds.

Key words: *Glomus*, rhizosphere, spores, VAM fungi, sunflower

VAM fungi form symbiotic association with most of the economically important plants. They develop a network of microscopic filaments in soil. They become established in plant root cortical cells by forming hyphae, arbuscules and vesicles whereas spores are differentiated in the rhizosphere. There is bidirectional movement of nutrients between the fungus and the plant roots. The spores grow in the soil as well as roots. The VAM spores act as reserve and propagating structures and reference structure for species identification of VAM fungi.

These fungi belong to Class Zygomycetes, Order Glomales and Family Glomaceae (Pirozynski and Dalpe, 1989 ; Morton and Benny, 1990). The bulk of known species belong to the among which *Glomus* is the most common with most diverse spore morphology.

Glomus is the most important mycorrhizal fungus for increasing the biomass of crop plants, in agriculture and forest management. The *Glomus*-plant symbiosis plays an important role in the economic sectors involving the growth of plants such as agriculture, horticulture, and forestry. As a fungi, *Glomus*, contributes to fungal biomass dominance of soils.

Many workers have reported the occurrence and diversity of VAM fungi from different plant hosts. Only few workers have studied VAM fungi in ornamental plants. It is essential to characterize the biodiversity of VAM fungi in plants of economical significance. With this objective, this investigation has been conducted to isolate and identify the species of *Glomus* in Sunflower *(Helianthus annuus*), a common ornamental and oil yielding annual belonging to family Asteraeceae. Seven species of *Glomus* are encountered and identified on the basis of their morphological characters. The spores were extracted from its rhizosphere.

Soil samples were collected from the rhizospheres of the Sunflower plants from different sites of Allahabad (Uttar Pradesh). Rhizospheric soils at a depth of 4-16 cm were collected in sterile polythene bags using soil auger. Spores of VAM fungi were extracted from the soil by wet sieving and decanting technique (Gerdemann and Nicolson, 1963). For taxonomic purpose, spores were mounted in PVLG medium.

Seven species of the genus *Glomus* were isolated and identified by using manuals of ,Morton and Benny (1990), Schenck and Perez (1990) and Mukerji (1996).

Glomus

Spores are borne terminally on a single undifferentiated hypha; spores attached with one or more

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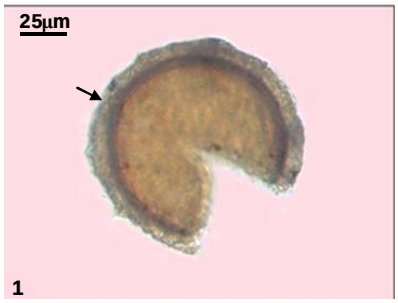


Fig.1: A single spore of *Glomus cerebriformae* showing swelling of outer wall

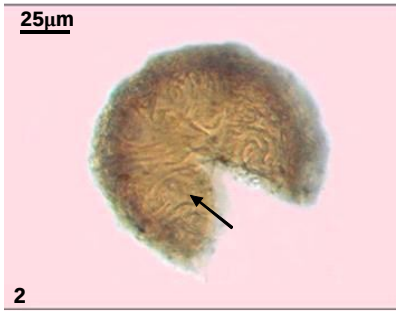
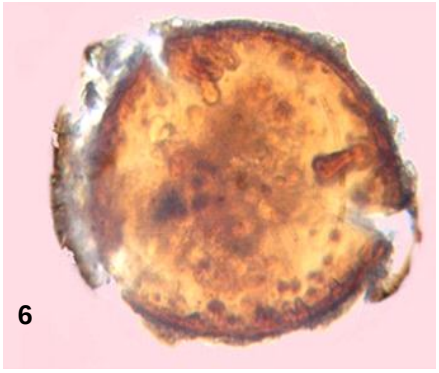


Fig. 2: Spore of *G. cerebriformae* with cerebriform content

Fig. 3: A single spore of *Glomus intraradices* with subtending hypha

Fig. 4 : Spores of *G. intraradices* in cortical tissue of root

Fig. 5: A typical white spore of *G. lacteum* showing two subtending hyphae



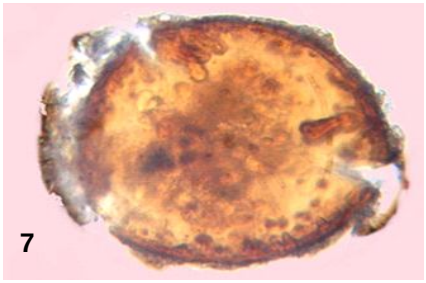


Fig. 6 , 7: Spores of *G. macrocarpum* showing lignitubers and subtending hypha

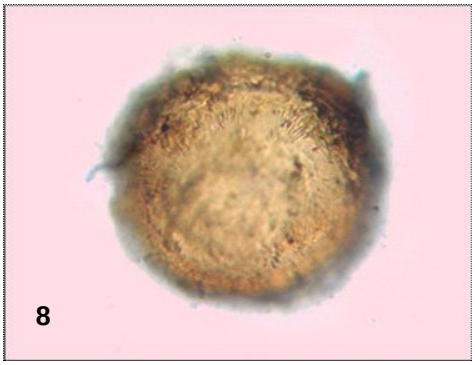


Fig. 8: A single spore of *G. monosporum* showing echinulate ornamentation

Fig. 9 : Spore of *Glomus pansihalos* showing swelling in its outer wall with yellow radiating columns

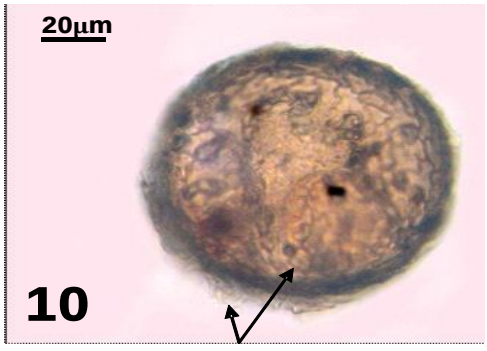


Fig. 10: Spore of *G. tortuosum* showing sinuous hypal mantle

subtending hyphae; spores produced singly or in loose or tight aggregates or in sporocarps in soil. The spores are formed at the end of hyphae which may be constricted at the point of attachment to the spore. The spore wall can have one to many layers, without ornamentation. The taxonomy of spores of *Glomus* species that encountered during this survey is as under:

***Glomus cerebriformae* McGee**

Spores found singly in soil, globose, yellowish-brown to brown, 84μm in diameter, cerebriform spore content. Spore wall is consisting of two walls (wall 1 and 2) in a single group. Wall 1 hyaline to pale yellow, laminated and dull roughened and it swells in lactic acid and occasionally an outer flaky layer is apparent. Wall 2 yellowish-brown, membranous, separable and flexible. Subtending hypha not observed (Fig. 1,2).

***Glomus intraradices* Schenck and Smith**

Spores formed singly or in clusters in roots, rarely formed outside the root in the soil, globose to subglobose, 39-45 μm x 42-53 μm, inner walls darker than outer walls. Spore content with yellow to light brown oil globules. Spore wall structure consists of two laminated walls (walls 1 and 2) in a single group. Wall 1 ephemeral, extends down the hyphal attachment generally separate from inner walls. Wall 2 yellow to light brown, darker than outer wall, laminated. Walls extend down into hyphal attachment forming an apparent tubaeform flare at the junction with hyphal attachment. Subtending hypha wide at a point of attachment, cylindrical, straight occasionally constricted (Fig. 3,4).

***Glomus lacteum* Rose and Trappe**

Spores borne singly in soil, globose to subglobose, white, smooth, 76 μm in diameter. Spore wall structure consists of a single wall (wall 1), light yellow to light yellowish-brown, laminated. Subtending hyphae 2 in no., wide at a point of spore attachment, hyaline, two hyphae often grow parallel to each other for some distance then they merge to form a single hyphal attachment, hyphal pore open or closed by wall septum (Fig. 5).

***Glomus macrocarpum* Tulasne and Tulasne**

Spores occur singly in soil or in loose aggregations, spore spherical or oval, 123-148 μm x 132-148 μm. Spore wall structure consists of double wall (walls 1 and 2) in a single group. Wall 1 hyaline, swells in lactic acid and evanescent. Wall 2 yellow to dark brown, laminated, pitted or perforated with lignitubers formed by the action of hyperparasite. Subtending hypha single, straight, cylindrical, taper to the point of hyphal attachment, wide at spore base. The spore wall 2 occludes the hyphal pore at maturity, wall 2 thickening continued into the subtending hypha (Fig. 6,7).

***Glomus monosporum* Gerdemann and Trappe**

Spores formed singly in soil, globose to sub globose, 92μm in diameter, light brown in colour. Spore wall structure consists of double wall (walls 1 and 2) together. Wall 1 is outermost, thin, hyaline to pale yellow and evanescent. Wall 2 is innermost, dull brown, thicker than outer wall, laminated with minute abundant to scattered echinulations that protrude into the outer wall (Fig. 8).

***Glomus pansihalos* Berch and Koske**

Spores borne singly in soil, globose to subglobose, yellow, 47 μm x 50 μm in diameter. Spore wall structure consists of three walls (Walls 1-3) in a single group, walls separable. Wall 1 hyaline in water mountant, expanding, granular, swells in lactic acid into roughened, hyaline or light yellow columns that radiate from outer surface of wall 2. Wall 2 yellow-orange to brownish orange, laminated, outer surface covered with hemispherical or rounded warts. Wall 3 yellow-orange, unit wall (Fig. 9).

***Glomus tortuosum* Schenck and Smith**

Spores borne singly in soil, 92 μm x 98 μm in diameter, yellow to dull brown with a mantle of sinuous hyphae closely appressed to the spore, hyaline to brown, mantle frequently with adhering debris and soil particles. Spore wall structure consists of a single, thin, laminated wall (Fig.10).

Earlier, Sharma *et al.* (2008) also reported seven species of Glomus from the sunflower rhizosphere of Haryana.

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