

# Association of vesicular-arbuscular mycorrhizae with ginger rhizosphere in Himachal Pradesh

Sanjeev Sharma and N.P. Dohroo

Department of Mycology and Plant Pathology, Dr. Y.S. Parmar University of Horticulture and Forestry, Solan (H.P.) -173 230, India.

## Abstract

Seven species of VAM fungi were found associated with ginger rhizosphere in Himachal Pradesh. They included *Glomus mosseae*, *G. caledonicum*, *G. pulvinatum*, *Acaulospora laevis*, *A. scrobiculata*, *Gigaspora albida* and *Scutellospora minuta*. Among the different VAM fungi species, frequency of *Glomus* species was maximum. The morphological characters of these VAM fungi are described.

**Key words:** VAM fungi, ginger, rhizosphere, *Glomus mosseae*, *G. caledonicum*, *G. pulvinatum*, *Acaulospora laevis*, *A. scrobiculata*, *Gigaspora albida*, *Scutellospora minuta*

## Introduction

The ability of vesicular-arbuscular mycorrhizal (VAM) fungi to produce a dramatic response in plant growth is well documented (Gerdemann, 1968, Mosse, 1973, Sharma and Dohroo, 1996). Since VAM fungi are ubiquitous in almost all types of soils, it is common to observe these fungi interacting with soil borne plant pathogens in the same root (Smith, 1988). Ginger (*Zingiber officinale* Roscoe), a cash crop of low and mid hills of Himachal Pradesh, is severely attacked by soil borne pathogens (*Pythium* spp. and *Fusarium* spp.), which causes huge loss to the growers. The occurrence of mycorrhizae in ginger rhizosphere is not documented but the association of VAM fungi with scale-like leaves of rhizomes has been reported (Taber and Trappe, 1982). Most plants in natural ecosystem are assumed to produce mycorrhizal associations, although mycorrhizal status for the vast majority of plants has not been confirmed (Newman and Reddell, 1987). VAM-induced change in root exudates and resulting alteration of rhizosphere mycoflora has brightened its scope in biological control of root pathogens (Bagyaraj, 1984). The objective of this study was to collect and identify species of VAM fungi associated with ginger rhizosphere soil so that the findings of present investigations can be utilized in the integrated management of ginger diseases, as these fungi are most suitable biofertilizers as well as biocontrol agents. Although this was not an exhaustive taxonomic/ecological study, the information presented extends the distribution of seven VAM fungal species in ginger rhizosphere soil.

## Materials and methods

Rhizosphere soil samples along with roots of ginger plants were collected from Solan, Sirmaur and Shimla districts of Himachal Pradesh, the major ginger producing districts of the state. Twenty five to fifty samples were collected from each district depending upon the area under ginger cultivation in the district. The samples were collected from eight random places in a field and pooled in polythene bags. The soil samples were carried to the laboratory and stored in a refrigerator at 4°C till isolation of VAM fungi.

The isolation of VAM fungal spores was carried out by wet-

sieving and decanting method (Gerdemann and Nicolson, 1963). Twenty five gram soil was mixed in a convenient volume of water in a large beaker (500 ml) and stirred with a glass rod to make uniform suspension. The suspension was left undisturbed for 5 min to allow the heavier particles to settle. Then the suspension was decanted through 1000, 300, 250, 125, 105 and 45 mesh size sieves and the remains on the sieves were washed into beakers. This process was repeated 8 to 9 times to trap all spores of VAM fungi. After settlement of heavier particles, the supernatant was filtered through gridded filter papers. Each filter paper was spread onto a microslide and scanned under a dissecting microscope at 40 X magnification.

The VAM fungal spores as loose clusters or as sporocarps and chlamydo spores were picked up with Pasteur pipette and were mounted in polyvinyl lactic acid (Omar *et al.*, 1979). Identification work was carried out by referring to the photographic slide collections together with the synoptic key of Hall and Abbott (1983) and also standard keys of Gerdemann and Trappe (1975), Trappe (1987) and Hall (1984). The identity of majority of isolates was confirmed by the courtesy of the Department of Plant Pathology, IARI, New Delhi. The size, colour, details of the wall layers and the nature of subtending hyphae were recorded as per the relevant literature (Hall, 1984; Schenck and Perez, 1987).

## Results and discussion

After detailed morphotaxonomic study, photomicrographs were compared with the already described mycorrhizal fungi. Seven mycorrhizal fungi were isolated from ginger rhizosphere soil representing different areas in northern India. The majority of mycorrhizal fungi were species of *Glomus*. The morphological characteristics of spores of mycorrhizal fungi isolated from ginger soils are given below:

***Glomus mosseae* (Nicol. & Gerd.) Gerd. and Trappe:** The spore size varied from 106.4-228.0 x 114.0-311.6 µm. The colour of the spores was brown in all the cases. The spores were bilayered and wall thickness ranged from 3.8-7.6 µm. Chlamydo spores had funnel-shaped subtending hypha with a cup-shaped septum.

***G. caledonicum* Gerd. & Trappe:** The spore diameter measured 152.0 x 216.6µm and colour was yellow to brown. The spore was bilayered and wall thickness measured 3.8 µm. Chlamyospore had a funnel-shaped subtending hypha. The outer layer of the spore wall extends down the subtending hypha as a loosely fitting sleeve. A septum extends across the subtending hypha some distance below the point of attachment to the spore.

***G. pulvinatum* Trappe & Gerd.:** The spore measured 87.4 x 91.2µm in diameter and was brown in colour. The spore had single layer with a thickness of 1.9µm. Spores had a distinct flat septum at the point of attachment of the subtending hypha to the spore.

***Acaulospora laevis* Gerd. & Trappe:** The colour of the spores was hyaline to yellow and measured 247.0 x 273.6µm in diameter. The spores were two-layered and wall thickness was 3.8µm.

***A. scrobiculata* Trappe:** The spore colour was yellow to brown and diameter was 114.0 x 121.6 µm. The wall was bilayered and its thickness measured 3.8 µm. Surface of the outermost wall layer was ornamented with pores.

***Gigaspora albida* Schenck & Smith:** The colour of spore was yellow or hyaline and wall was bilayered. The spore diameter and wall thickness measured 87.4 x 140.6µm and 7.6µm, respectively. Spores were invariably formed on a single bulbous shaped subtending hypha which had short lateral projections.

***Scutellospora minuta* Walker & Sanders:** The spores had brown colour and were bilayered. The spore diameter and wall thickness measured 87.4 x 106.4µm and 3.8 µm, respectively. The species had spores with a coriaceous wall.

Spores extracted were critically scanned for generic level distribution of VA mycorrhizae. *Glomus* was the predominant genus and contributed 72.88 % of the spore population (Fig. 1). In general *Scutellospora* spp. was next to *Glomus* spp. in distribution followed by *Acaulospora* and *Gigaspora* species in descending order.

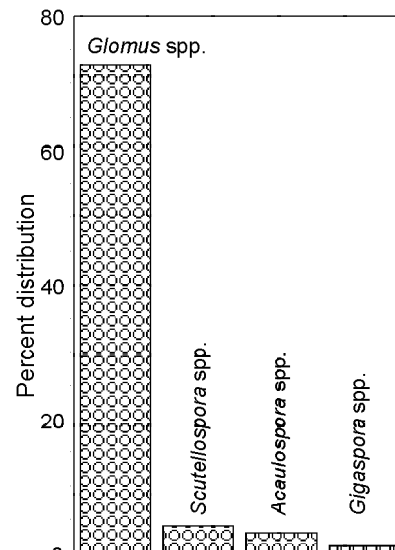
In the present investigation, seven different mycorrhizal fungi were isolated from ginger rhizosphere soil. Out of these fungi, frequency occurrence of *Glomus* spp. was maximum and illustrates its universal occurrence. In the light of above findings, we summarize that the mycorrhization in ginger may prove an effective tool in the management of ginger diseases, which are menace to its growers in northern India.

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**Fig. 1. Generic level distribution of VA mycorrhizal spores in ginger producing districts of Himachal Pradesh**

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