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Arbuscular Mycorrhizal Diversity Across Plant Types in an Undisturbed Natural Habitat within an Urban landscape in Ahmedabad, India

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ABSTRACT

This study investigates the diversity of arbuscular mycorrhizal fungi in an undisturbed vegetated natural zone of the St. Xavier's College campus, Ahmedabad. A total of 30 plant species- comprising trees, shrubs, and herbs- were assessed, and rhizospheric soil samples were collected to evaluate AMF spore density, fungal diversity, and soil parameters (organic carbon, nitrogen, phosphorous and potassium). Tree- associated soils exhibited the highest spore counts, ranging from 169 to 1600 per 100 g, suggesting favourable conditions for AMF symbiosis. AMF presence showed a strong association with phosphorous and nitrogen availability. A neutral to slightly alkaline pH, a slighly saline electrical conductivity and moderately present organic carbon in the soil across all the plant types favoured AMF presence. A total of 20 species belonging to 10 genera of AM fungi were identified of which *Glomus* spp., *Acaulospora* spp., and *Rhizophagus* spp., were found to be dominant. These findings emphasize the ecological value of undisturbed habitats like those within the college campus, which serve as natural repositories of diverse AMF communities crucial for plant health and ecosystem resilience.

Keywords: Diversity, herbs, Arbuscular, Mycorrhiza, AMF, phosphorous, shrubs, soil, trees

INTRODUCTION

Arbuscular Mycorrhiza has long been a focal point of scientific inquiry, owing to its profound impact on nutrient absorption and its multifaceted ecological functions (Smith *et al*., 2008). AMF (arbuscular mycorrhizal fungi) are one of the few plants' fungal associations with a fossil record which may have facilitated the origin of land flora (Varma *et al*., 1998). The complex functioning of ecosystems can be understood by studying the symbiotic interaction between fungi and plant roots, which has attracted substantial interest. Mycorrhizal symbiosis, defined as the entwining of fungal hyphae and plant roots, forms beneficial partnerships that enable the mutual exchange of resources and nutrients, that are essential for plant development and health. The most common and ancient mycorrhizas, AMF, create complex webs of fungal hyphae that penetrate the root cortex and develop arbuscules as sites of nutrition exchange within plant cells. AMF operates as an "underground superhighway", extending a wide network of hyphae beyond plant roots to access nutritional supplies like nitrogen and phosphate that are frequently trapped in the soil and delivering them straight to plants. AMF play a crucial role in ecosystem processes by linking plant nutrient cycles and influencing biodiversity, carbon cycling and soil structure (Miller and Kling, 2000), (Rillig, 2004). Arbuscular mycorrhizal fungi exhibit significant diversity in their extraradical mycelium structure, influencing nutrient uptake efficiency. (Dodd *et al*., 2000). Interconnected mycelial networks facilitate resource sharing across large distances, benefitting symbiotic relationships (Rayner *et al*., 1995). Mycorrhizae's enzymatic pathways enhance phosphorus absorption, highlighting its vital role in plant development, energy generation, further highlighting the significance of mycorrhiza research in expanding our understanding of this symbiotic relationship. Plants that have mycorrhizal fungus may withstand a wider range of environmental stresses, such as infections, drought, salt, and heavy metals. They accomplish this by increasing absorption of water, controlling hormones in plants, and generating defence mechanisms (Rayner *et al*., 1995). AMF not only enhance plant growth by improving nutrient uptake but also influence plant-pathogen interactions. They may reduce the harmful effects of certain fungal pathogens while sometimes exacerbating nematode infections, indicating complex ecological relationships (Borowickz *et al*., 2001). As part of the research project 'Assessment of the Mycorrhizal Diversity in the Soil of St. Xavier's College (Autonomous), Ahmedabad, and its relative effect on plant growth as a Biofertilizer', a study in an undisturbed area of the

campus highlighted the significant benefits of mycorrhizae on plant vitality, soil health, revealing a promising yet underexplored ecological relationship. The diverse microhabitats within St. Xavier's College campus offer a unique condition for mycorrhizal colonization and plant interactions, making it a promising yet underexplored research site. This study is the first of its kind to simultaneously assess AMF diversity across herbs, shrubs and trees within a single campus environment.

MATERIALS & METHODS

Sampling Site

This research, employed a comprehensive approach to study the complex relationships between plants and AM Fungi. The study focused on an undisturbed area known as the "Cactus House Area" of the college campus. (23 01'53" N 72 33' 05" E)

Collection of soil sample

The soil samples were collected to ensure a broad spectrum of data. The soil samples were collected carefully, close to the root of each plant selected for the study by digging at a depth of 36-40 cm. A total of three replicates were collected for each plant species. The sampling was conducted during the winter season, specifically in the months of January and February. Each soil sample was wrapped in a paper, placed in a zip-lock bag and labelled with pertinent details i.e., name of the plant species, the date of collection, and location. The potential seasonal influence on AMF diversity and spore density is currently being monitored as part of an ongoing study.

Physical and chemical analysis of soil

Significant insights into soil characteristics were obtained using various soil analysis techniques. The pH was determined using a pH meter (Equiptronic Model EQ-611), and electrical conductivity was measured using an E.C. meter (HM Digital HM AP-2). Phosphorus, nitrogen, and potassium levels were analysed using the Olsen Method (1954), Kjeldahl Method (1883), and Ammonium Acetate method (Standford and English, 1949) respectively. The percentage of organic carbon was estimated using the Walkley-Black method (1934).

Isolation and observation of arbuscular mycorrhizal fungi

Arbuscular mycorrhizal fungi were isolated using the methods described by Gerdmann and Nicolson (1963), which involve extracting and observing AMF spores using the Wet Sieving and Decanting Method. The sieves used in the study were of 53 and 106 μm.

AMF identification

Individual AMF spores were carefully isolated with a 0000- grade fine pencil brush under a stereomicroscope (Almicro DS-50). The isolated spores were then transferred on to clean glass slides containing a drop of polyvinyl lactoglycerol (PVLG) solution and a coverslip was gently placed to ensure proper mounting. The prepared slides were allowed to dry at room temperature for 24 hours to facilitate proper cleaning and adhesion. For morphological identification, the prepared slides were examined under an optical digital microscope. Identification of AM fungal spores was carried out using the taxonomic key provided by Schenck and Perez., 1990. Additionally, the morphological characteristics such as spore size, color, wall structure, subtending hyphae, and surface ornamentation were cross- verified using descriptions form online database, the International Culture Collection of Vesicular Arbuscular Mycorrhiza (INVAM).

Statistical Data Analysis

The data were processed by calculating the average of all replicates for each plant species using Excel. The standard deviation (SD) was computed to measure the variability of the data points around the mean, and the standard error (SE) was calculated to represent the precision of the mean estimate. These analyses provided substantial information about the distribution and characteristics of mycorrhizal spores across various plant groups in the St. Xavier's College campus ecosystem.

RESULTS

The data on arbuscular mycorrhizal (AM) spore count and associated soil physical parameters for trees, shrubs and herbs are summarized in **Table 1**, **Table 2**, and **Table 3**, respectively. A total of 30 soil samples were analyzed- 18 from tree species, and 12 from shrubs and herbs with each group comprising 6 distinct species.

Table 1: AM Spore count and associated Soil physical parameters for Tree species

Scientific Name of Tree Species	No. of Spores (per 100g of soil)	pH	E.C. (µs/cm)	Organic Carbon (%)	Nitrogen (kg / hac)	Phosphorous (kg/hac)	Potassium (Kg/hac)
Azadirachta indica A.Juss.	1313 ± 0.208	7.895 ±0.019	295 ±1.689	0.805 ±0.061	109	58	850
Berrya cordifolia (Wild) Burret	169± 0.620	7.825 ±0.012	631 ±0.112	0.813 ±0.08	208	102	595
Cordia rothii Roem. & Schult.	297± 1.064	7.215 ±0.008	361 ±0.342	1.34 ±0.095	152	76	620
Dendrocalamus strictus (Roxb.) Nees	988± 0.721	7.18 ±0.127	365 ±3.897	0.7 ±0.084	195	136	855
Eucalyptus globulus Labill.	1600± 1.696	7.22 ±0.048	399 ±1.55	1.311 ±0.058	169	130	420
Fernandoa adenophylla (Wall. ex G.Don) Steenis	896± 0.833	7.125 ±0.021	187 ±0.511	0.6205 ±0.069	93	18	885
Ficus amplissima Sm.	389± 1.678	7.465 ±0.065	202 ±0.351	0.675 ±0.06	138	88	625
Holoptelea integrifolia (Roxb.) Planch.	1263± 0.863	7.59 ±0.025	214 ±0.478	0.255 ±0.089	203	144	995
Livistona rotundifolia (Lam.) Mart.	1259± 0.286	7.33 ±0.003	237 ±0.195	0.455 ±0.096	226	188	725
Peltophorum pterocarpum (DC.) Backer ex K.Heyne	965± 1.311	7.91 ±0.007	275 ±1.628	0.915 ±0.047	111	75	660
Pithecellobium dulce (Roxb.) Benth.	1262± 1.176	7.725 ±0.0521	238 ±0.129	0.51 ±0.042	177	42	995
Polyalthia longifolia (Sonn.) Benth. & Hook.f. ex Thwaites	902± 0.819	7.71 ±0.014	445 ±1.896	0.28 ±0.075	102	26	695
Pongamia pinnata (L.) Pierre	1004± 0.592	7.485 ±0.009	322.5 ±1.14	0.525 ±0.103	165	60	995
Pterospermum acerifolium (L.) Willd.	287± 0.454	7.345 ±0.061	245.5 ±0.479	1.212 ±0.084	103	84	785
Putranjiva roxburghii Wall.	965± 0.754	7.7± 0.039	320 ±1.174	0.765 ±0.051	98	94	300
Senna siamea (Lam.) H.S.Irwin & Barneby	734± 1.184	7.455± 0.068	247 ±1.108	0.907 ± 0.024	123	66	915
Tamarindus indica L.	1143± 1.699	7.195± 0.001	366.5 ±1.227	1.015 ±0.064	212	102	995

Among the tree species **(Table 1)**, *Eucalyptus globulus* exhibited the highest AMF spore count with 1600 spores per 100 g of soil, followed by *Azadirachta indica* (1313), *Holoptelea integrifolia* (1263), *Pithocelobium dulce* (1262), *Livistonia rotundifolia* (1259), *Tamarindus indica* (1143), and *Pongamia pinnata* (1004). These species are native and hardy, well-adapted to the local environmental conditions, which may explain their strong association with AMF species to support nutrient

uptake and stress tolerance, The pH of soils collected from tree rhizospheres ranged from 7.0-7.9, indicating a neutral to slightly alkaline nature. Electrical conductivity (EC) varied from 187-631 µS/cm, with the highest value observed in *Berrya cordifolia* (631 µS/cm) and the lowest in *Fernandoa adenophylla* (187µS/cm). Nitrogen content ranged between 90-230 kg/ha, with *Fernandoa adenophylla* showing the lowest value (93 kg/ha) and *Livistonia rotundifolia* the highest (226 kg/ha).

Phoshorous levels were found to range from 18 to 188 kg/ha, with *Fernandoa adenophylla* showing the lowest value (18 kg/ha) and *Livistonia rotundifolia* showing the highest value (188 kg/ha). Potassium levels were found to range from 300 to 995 kg/ha, with the minimum recorded in *Putranjiva roxburghii* (300 kg/ha), while *Holoptelea integrifolia*, *Pithocelobium dulce*, *Pongamia pinnata*, and *Tamarindus indica* exhibited the maximum value (995 kg/ha). Organic carbon content in soils associated with tree species ranged from 0.2% to 1.5%, reflecting moderate variability in soil organic matter.

The data for shrub species is presented in **Table 2**. Among the six shrub species assessed, *Ixora pavetta* recorded the highest AMF spore count with 852 spores per 100 g of soil, followed closely by *Barleria priontis* (832) and *Abutilon indicum* (814), while the lowest spore count was observed in *Capparis sepiaria* (408). Compared to tree species, the variation in shrubs spore count was relatively narrow, which may reflect the more limited root systems of shrubs in contrast to trees that typically develop extensive root networks supporting higher AM colonization. Soil pH in shrub samples ranged from 7.0-7.5, indicating a neutral to slightly alkaline environment similar to that of trees. Electrical conductivity (EC) values ranged from 160-360 µS/cm, with lowest EC recorded in *Hibiscus rosa-sinensis* (162 µS/cm) and the highest in *Abutilon indicum* (356 µS/cm). Nitrogen levels varied from 90-260 kg/ha, with *Phyllanthus reticulatus* showing the lowest nitrogen content (93 kg/ha) and *Abutilon indicum* the highest (257 kg/ha). Phosphorous content ranged from 5 to 152 kg/ha, with *Phyllanthus reticulatus* again showing the lowest value (6 kg/ha) and *Abutilon indicum* showing the maximum (152 kg/ha). Potassium levels were recorded between 370-995 kg/ha, with *Hibiscus rosa -sinensis* exhibiting the lowest value (375 kg/ha) and *Abutilon indicum* the highest (995 kg/ha). The Organic carbon percentage across shrub samples ranged from 0.2 to 1.5%, indicating a moderate level of soil organic matter similar to that observed in tree- associated soils.

The data for herbaceous species is summarized in Table 3. Among the six herb species studied, *Acalypha indica* recorded the highest AMF spore count at 689 spores per 100 g of soil, followed by *Alternanthera sessilis* (659) and *Ruellia prostrata* (535), while *Asystasia gangetica* exhibited the lowest spore count at 238. These values reflect a further reduction in AM spore density compared to shrubs and trees, likely due to the relatively shallow and less extensive root systems of herbaceous plants, which may limit the extend of mycorrhizal colonization. Soil pH in the herb-associated samples ranged from 7.0 to 7.5, indicating neutral to slightly alkaline conditions, consistent with the trend observed in tree and shrub species. Electrical conductivity (EC) values varied between 220-670 µS/cm, with *Alternanthera sessilis* showing the highest EC (670 µS/cm) and *Acalypha indica* the lowest (270 µS/cm). Nitrogen content ranged from 115 to 200 kg/ha, with *Peristrophe paniculata* exhibiting the lowest nitrogen value (117 kg/ha) and *Asystasia ganetica* the highest (198 kg/ha). Phosphorous content ranged between 50 an 130 kg/ha, with *Peristrophe paniculata* showing the minimum (50 kg/ha) and *Asystasia gangetica* the maximum (130 kg/ha). Potassium levels spanned from 500 to 995 kg/ha, with *Peristrophe paniculata* recording the lowest value (515 kg/ha), while *Acalypha indica* and *Ruellia prostrata* showed elevated levels at 905 and 995 kg/ha, respectively. The Organic carbon content in the herbaceous soils ranged from 0.5- 1.5%, indicating a moderately rich organic matter content across the herb species assessed.

Table 4 presents the distribution of AMF genus across the plant types. A total of 20 species belonging to 10 genera of AM fungi were identified. From those 4 species belonged to Glomus, 2 to Rhizophagus, 2 to Paraglomus, 2 to Archaespora, 3 to Septoglomus, 2 to Gigaspora, 1 to Sclerocystis, 1 to Scultellospora, 2 to Acaulospora, 1 to Funneliformis. Of all the Genera, *Glomus* was the most dominant across all the plant types, followed by *Acaulospora* and *Rhizophagus*.

Table 2: AM Spore count and associated Soil physical parameters for Shrub species

Scientific Name of Shrub species	No. of spores (per 100g of Soil)	pH	E.C. (µS/cm)	Organic Carbon (%)	Nitrogen (kg / hac)	Phosphorous (kg/hac)	Potassium (kg/ hac)
Abutilon indicum L.	814 ±0.347	7.285 ±0.005	356 ±0.716	0.785 ±0.028	257	152	995
Barleria prionitis L.	832 ±1.221	7.27 ±0.018	211 ±0.481	0.7225 ±0.05	145	84	550
Capparis sepiaria L.	408 ±1.691	7.47 ±0.078	191±0.109	0.096 ±0.019	102	48	770
Hibiscus rosa-sinensis L.	560 ±0.783	7.47 ±0.015	162 ±0.511	0.0545 ±0.041	95	44	375
Ixora pavetta Andr.	852 ±0.909	7.255 ±0.023	222 ±0.302	0.895 ±0.089	131	64	695
Phyllanthus reticulatus Poir.	529 ±1.281	7.12 ±0.014	237 ±0.195	1.003 ±0.002	93	6	560

Table 3: AM Spore count and associated Soil physical parameters for Herb species species

Scientific Name of Herb Species	No. of Spores (per 100g of Soil)	pH	E.C. (µS/cm)	Organic Carbon (%)	Nitrogen (kg / hac)	Phosphorous (kg/hac)	Potassium (kg/ hac)
Acalypha hispida Burm. f.	689 ±1.749	7.225 ±0.009	220 ±0.505	1.3 ±0.035	146	76	905
Alternanthera sessilis (L.) DC.	659 ±0.281	7.435 ±0.009	670 ±0.869	0.575 ±0.086	142	76	620
Asystasia gangetica (L.) T.Anderson	238 ±0.738	7.32 ±0.039	370.5 ±0.18	0.517 ±0.073	198	130	650
Peristrophe paniculata (F orssk.) Brummitt	246 ±1.839	7.175 ±0.024	245 ±1.341	1.545 ±0.084	117	50	515
Plumbago zeylanica L.	269 ±1.72	7.52 ±0.018	364 ±0.55	1.137 ±0.016	220	122	760
Ruellia prostrata Poir.	535 ±1.592	7.07 ±0.021	293 ±0.35	1.17 ±0.055	123	58	995

Table 4: Arbuscular mycorrhizal Genus and its distribution across plant types

Name of the Genus of AM Fungi	Plant Habit
Acaulospora	Trees, Herbs, Shrubs
Archaespora	Shrubs
Funneliformis	Trees
Gigaspora	Herbs, Shrubs
Glomus	Trees, Shrubs, Herbs
Paraglomus	Shrubs
Rhizophagus	Trees, Shrubs, Herbs
Sclerocystis	Trees
Scutellospora	Trees
Septoglomus	Herbs

Arbuscular mycorrhizal spores were observed across all plant types, including *Rhizophagus aggregatus, Gigaspora albida, Archaespora trappei, Paraglomus* spp.., more prevalent in shrubs, Sporocarp of *Gigaspora sp*s., *Rhizophagus fasciculatus*, *Septoglomus constrictum, Septoglomus deserticola* in herbs, and *Funneliformis geosporum* and *Acaulospora laevis, Glomus claroideum, Glomus macrocarpum, Scutellospora* spp.*, Sclerocystis sinuosa, Rhizophagus aggregatus* in trees. The dominant species of arbuscular mycorrhizal fungi (AMF) were identified as *Rhizophagus aggregatus*, *Glomus claroideum, and Acaulospora laevis* across the three plant categories suggesting their broader range.

DISCUSSION

This section presents the results of various chemical soil parameters, including phosphorous, nitrogen, potassium, organic carbon, pH, and electrical conductivity, across three different plant habit types: trees, shrubs, and herbs. These results are integrated with data on mycorrhizal spore density obtained from each soil sample. The relationship between soil parameters and mycorrhizal colonization is analyzed to understand how variations in nutrient composition and soil parameters influence the distribution of arbuscular mycorrhizal fungi. The potential ecological implications of these interactions are also discussed in this section. The findings have been discussed below which highlight the importance of mycorrhizal associations in soil fertility and plant health, warranting further investigation into their ecological and agronomic significance.

Mycorrhizal spore counts across plant categories. The study carefully analysed the number of AMF spores, diversity and the plant-mycorrhizal relationship associated with different plant categories, providing a comprehensive understanding of the symbiotic relationships between the two. Different plant species show differing levels of mycorrhizal specialization, which may prefer particular mycorrhizal fungi and cause differences in the distribution of spore counts among various plant categories. The average number of mycorrhizal spores per 100 grams of soil varied considerably among the trees, ranging from 169 to 1600 spores per 100 g of soil. *Eucalyptus globulus* Labill. exhibited the highest spore count (1600 spores), while *Berrya cordifolia* (Willd.) Burret had the lowest (169 spores). This significant mycorrhizal fungal population surrounding trees underscores the importance of their deep root systems and their reliance on symbiotic relationships for nutrient uptake. In contrast, the average number of spores in shrubs ranged from 400 to 850, with *Capparis sepiaria* L. showing the lowest count at 408 and *Ixora pavetta* Andr. the highest among the species studied. The mycorrhizal spore concentration in herbs was the lowest, ranging from 200 to 840 per 100 grams of soil. This indicates a lesser dependence on mycorrhizal associations for nutrient uptake compared to trees and shrubs. Among herbs*, Asystasia gangetica* (L.) T. Anderson had the lowest spore count at 238, while *Acalypha indica* Burm. f. had the highest at 689 per 100 grams of soil sample. These spores are the means of survival of mycorrhiza in adverse soil conditions (Sutton *et al*., 1972). The spore count depicts the association with the plant species which play a significant role in vesicular- arbuscular mycorrhiza formation and are key component of the rhizosphere microflora (Mosse *et al*., 1968). The quantity of AMF spores in Rhizosphere soil varies among different plant species even when they share the same habitat. This suggests that AMF distribution is influenced more by the plant species rather than the zonation pattern of the vegetation (Alrajhei *et al*., 2021, Van der Heijden *et al*., 1998).

Nutrient availability and mycorrhizal spore numbers. This study provides valuable information on the relationships between mycorrhizal spore numbers, soil properties, and nutrient availability across various plant species. The soil in this study exhibited a neutral to slightly alkaline soil (pH 7.0-7.9) across all the samples. This pH is considered optimal for AM fungal growth and aligns with the observation that AMF can thrive in a range of alkaline conditions, although higher alkalinity tend to reduce AMF diversity (Fang *et al*., 2023), (SyamPrasad *et al*., 2020). The Electrical conductivity values ranged 162-670 µS/cm indicating low to moderate salinity which is favourable for AMF growth. It is suggested that higher EC values such as those observed in saline-alkali 790-2540µS/cm can limit AMF diversity (Fang *et al*., 2023). Arbuscular Mycorrhizal fungi play a crucial role in nutrient uptake, particularly

phosphorus, which aligns with the coevolutionary adaptations of plants and fungi (Brundrett, 2001). In the present study, available phosphorous in trees ranged from 18 to 188 kg/hac, in shrubs ranged from 44-152 kg/hac and in herbs ranged from 50 to 130 kg/hac. AMF facilitate phosphorous uptake in host plants through specialized signalling pathways that enhance nutrient exchange efficiency (Harrison, 2005), Shamini *et al*., 2014). Interestingly, species with higher phosphorus content had fewer mycorrhizal spores, suggesting a decreased reliance on fungal associations for nutrient intake. Soil phosphorus (P) is a key player. It has been observed that AMF extend their hyphae beyond the root zone, forming strategically placed network that enhances soil phosphate absorption beyond the depletion zone, making phosphorous more accessible to plants (Syam Prasad *et al*., 2020). These uptake of essential nutrients through AMF is also known to contribute to salt tolerance in plants (Evelin et al., 2009) and enhance resistance to pathogens and improved water-relations (Newsham *et al*., 1995). In our study, nitrogen ranged from 90 to 230 kg/ha for trees, 44 to 152 kg/ha for shrubs, and 50 to 130 kg/ha for herbs, indicating that trees are at the higher nitrogen end, while shrubs and herbs remain within the optimal range. Although nitrogen levels above 156 kg/ha are generally reported to negatively impact AMF colonization (Sreenivasa and Bagyaraj, 1991), our findings show high AMF spore counts even at higher nitrogen content in species like *Holoptelea integrifolia (203 kg/ha)*, *Livistonia rotundifolia (226 kg/ha)*, *Pithocellobium dulce (177 kg/ha)*, *Pongamia pinnata (165 kg/ha)*, *Dendrocalalmus strictus (195 kg/ha)*, and *Eucalyptus globulus (169 kg/ha)* remained high with 1263, 1259, 1262, 1004, 1600, 988 spores per 100 gram of soil respectively. This suggests that nitrogen alone may not be a limiting factor in AMF spore production in woody species, possibly due to combined effects of favourable pH, organic carbon, plant- microbe interactions, and seasonal influences. Also, the sampling season is winter (January- February), during which the mineralization is slower and nitrogen may be less available in forms that supress AMF.

Soil organic carbon content ranged from 0.24 to 1.44 percent. The study also highlights the importance of organic carbon in soil fertility and health, as it promotes the growth and activity of soil microbes, including mycorrhizal fungi. Spore abundance and organic carbon content had a slight positive association, suggesting a possible relationship between soil organic matter and mycorrhizal communities (Melo *et al*., 2019)

Mycorrhizal fungal diversity. The research explored the diversity of mycorrhizal fungi associated with trees, shrubs, and herbs in a natural undisturbed area of the college campus. AMF spores were detected across all plant types- shrubs, herbs and trees. Among the observed species, *Rhizophagus aggregatus*, *Gigaspora albida*, *Archaespora trappei*, and *Paraglmous* spp. were more commonly associated with shrubs. Herbs showed the presence of Sporocarp of *Gigaspora* spp., *Rhizophagus fasciculatus*, *Septoglomus constrictum*, and *Septoglomus deserticola*. In trees, prominent species included *Funneliformis geosporum*, *Acaulospora laevis*, *Glomus claroideum*, *Glomus macrocarpum*, *Scutellospora* spp., *Sclerocystis sinuosa*, and *Rhizophagus aggregatus*. Among these *Rhizophagus aggregatus*, *Glomus claroideum*, and *Acaulospora laevis* emerged as dominant AMF species across all three plant categories, indicating their broader ecological distribution and adaptability. In our study, Glomus and Acaulospora species were found to be dominant across various plant types with neutral to moderate saline conditions. This aligns with Akaji et al. (2021), who reported Glomeraceae to be prevalent even in high electrical conductivity like mangrove soil, suggesting their wide range og adaptation to variety of soil conditions. However, Acaulospora was reported to associate with lower salinity conditions in the same study. The high number of species found in these plant groups indicates a significant degree of mycorrhizal diversity in this undisturbed zone. These AMF spores may serve as a means of dispersal for AMF species. Species that associate with a broader range of plant hosts tend to have a wider geographical distribution, suggesting a link between host specificity and fungal dispersal (Opik *et al*., 2010). These findings highlight the importance of preserving intact areas to maintain stable ecosystems and rich fungal communities, which are essential for plant life and ecosystem resilience. Research on campus vegetation, confirms that AMF are widespread among plant species, with

variations in Spore counts and colonization rates influenced by soil conditions (Ferdousee *et al*., 2012, Htay *et al*., 2021).

Impact of cultivation on Arbuscular mycorrhizal diversity. In a similar type of work done by Khichi M. (2024), wherein an assessment of the mycorrhizal diversity in cultivated and disturbed parts of the St. Xavier's College Campus, Ahmedabad was done, a lower level of diversity was observed. The spore counts in cultivated areas ranged from 89 to 524 which significantly stands lower than the 200 to 1600 spore count observed in uncultivated locations. This substantial difference illustrates the negative impact of human activity on mycorrhizal loss in the maintained area of the campus, emphasizing the need for minimal soil disturbance to support mycorrhizal growth. In the cactus house area, as it remained undisturbed, it fostered the growth of AMF diversity in the years which can be clearly observed from the spore density count in the present study. Loss of host plants and soil disturbance disrupt established fungal networks. The undisturbed zone fostered a higher abundance of AMF, which might suggest that reduced soil disturbance enhances AMF colonization and hyphal network formation. This finding falls in line with Melo *et al*., 2019, suggesting that sites with higher organic matter and less human disturbance, support greater AMF spore diversity and root colonization, highlighting the importance of habitat quality in sustaining mycorrhizal symbioses. As AMF hyphae act as a physical network, binding soil particles together and reinforcing soil aggregates, this could contribute to improved soil structure and reduced erosion in undisturbed areas (Rillig *et al*., 2006). Intensive tillage, fertilizer application, and monoculture cropping disrupt established mycorrhizal networks and favour a limited number of AMF species (Harrison, 2005).

CONCLUSION

This study highlights the symbiotic relationship between plants and fungi, revealing that tree species host abundant AMF spores, indicative of healthy soil conditions. The absence of chemical fertilizers and human disturbances supports this favourable environment, with phosphorus availability playing a key role in spore abundance. Trees, due to their extensive root systems, exhibited higher AMF spore richness than shrubs and herbs. Future mycorrhizal research should shift focus from laboratory-based studies to field applications, emphasizing its real-world impact on plant growth and economic benefits (Jalali *et al*., 2020). Beyond scientific insights, this research highlights the educational value of studying plant-fungal symbiosis. Integrating hands-on mycorrhizal studies into academic curricula can enhance students' understanding of ecological interconnections and foster a deeper commitment to environmental conservation. Furthermore, the study emphasizes the need to protect naturally undisturbed areas within educational institutions, recognizing them as vital repositories of arbuscular mycorrhizal fungi. With rapid disappearance of natural habitats across various regions, conserving AMF is essential to ensure their sustainable use in the future (Bagyaraj *et al*., 2021). Hence, the Cactus House Area of St. Xavier's College Campus is proposed as a conserved AMF-rich site, offering students a dedicated space for future research and ecological learning.

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CONFLICT OF INTEREST

The authors declare about no conflict of interest.

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