ARBUSCULAR MYCORRHIZAL FUNGI ASSOCIATION IN SOME ORNAMENTAL PLANTS OF PARUL UNIVERSITY CAMPUS, WAGHODIA, VADODARA

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ABSTRACT

From different locations of Parul University, Waghodia, Vadodara, Gujarat Rhizospheric soil samples were collected. 12 ornamental plants were colonized with Arbuscular Mycorrhiza (AM) Fungi and were studied for root colonization. Between percent root colonization and spore number no correlation was found. In all the ornamental plants the diversity of AM Fungal spores were determined. Glomus spp were found predominant followed by Acaulospora, Scutellospora and Gigaspora by isolating and identifying four AMF spores up to genus level. The roots of Mycorrhiza plants with intense hyphal connection suggests the interconnecting fungal network in the Rhizosphere and appears to be the most effective method for nutrient transfer in an ecosystem. AM Fungi root colonization ranged from 12% to 99.4 % with higher value for Crinum asiaticum. Importance of AM Fungi with ornamental plants of Parul University campus garden has been discussed.

KEYWORDS: Ornamental plants, Arbuscular Mycorrhiza Fungi (AMF), Parul University campus garden, root colonization.

INTRODUCTION

Innumerable microorganisms have found soil as their natural home. Participation of Soil fungi and bacteria is important for the process of agriculture which includes mineralization, pesticide decomposition, disease production, nitrogen fixation, and promotion of growth promoters, soil system process, antibiotic production, soil formation and other biological processes. In various habitats, including soil and rhizosphere, fungi are abundantly found. The portion of the soil which is specialized in ecological niche is Rhizosphere and it is under the influence of the plant roots which includes the root surface and adhering soil. The microbes are stimulated by the root exudates, sloughed off cells and decaying roots. Rhizosphere soils have abundant Mycorrhizal fungi. Since 1880’s, Mycorrhizal association or fungus root is known (Frank, 1885). In most of the plants, the common Mycorrhizal association is Arbuscular type occurring in the majority of agricultural and horticultural crops. Plant roots transformation by these symbiotic fungi into unique morphological entities are called Mycorrhizae and these Endomycorrhizae produced by the non-septate fungi are generally known as “Arbuscular Mycorrhizal” (AM). Nature’s most ubiquitous constitute is AM Fungi and it occurs in varied soil. It is spread widely, interesting and is persistent example of parasitism. Non-septate Zygomycetous fungi forms the AM belonging to the genera Gigaspora, Glomus, Sclerocystis, Acaulospora, Enterophosphora, Scutellospora, Archaeospora and Paraglomus in the Glomales order. The obligate symbionts are the fungi and are not cultured on nutrient media. These endophytes
are not host specific. 90% of terrestrial plant roots forms a symbiotic association with these fungi and are commonly associated with pulses, cereals, fiber crops, ornamental and horticultural plants, aromatic and medicinal plants, weeds, trees, rhizoids and roots of Bryophytes, Pteridophytes, etc. In a root, energy moves primarily from plant to fungus and inorganic resources move from fungus to plant (Smith and Read, 1997) where there is a mutualistic symbiosis between plant and fungus, especially in AM Fungi. Many tropical plants including vegetables are colonized by AM Fungi. The growth of various crops including horticultural plants like Tomato and Carrot (Sasal 1991) is due to Arbuscular Mycorrhiza association. Many workers investigated improved plant growth mechanism due to Mycorrhizal inoculation. Increasing phosphate uptake by Mycorrhizal roots through greater soil exploration is well established. It also improved the uptake of limited elements like Zinc, Copper etc. Biological control of root pathogens, hormone production, biological nitrogen fixation and better ability to withstand water stress (Bagyaraj 1984) are the other beneficial effects. In this study ornamental plants grown in different locations of Parul University campus have been surveyed for AM Fungal association. Present investigation attempts were made to study AMF colonization in 12 ornamental plants belonging to 12 different families growing in Parul University, Vadodara. There are reports on the natural colonization and importance of AM with most of the ornamental, agricultural, medicinal, horticultural and floricultural plants. The information pertaining to the occurrence of AM Fungi with ornamental plants of Parul University garden is very meagre.

MATERIALS AND METHODS

The roots and Rhizospheric samples have been collected from 12 ornamental plants grown in the Parul University garden. AM Fungal propagules of the soil samples were isolated by wet-sieving and decanting method (Gerdemann and Nicolson, 1963) and identified up to genus level following Morton (1988), Schenk and Perez (1990), Morton and Redecker (2001). Plants were screened in Rabi season during the month of March and April 2021. For each species five plants were sampled. Plant roots were brought to the laboratory by digging out, which were then washed in tap water, free of soil and cut into the segments of 1cm length. Cleaning and staining of the roots were done with 0.05 percent Tryphan blue in Lactophenol as per the technique of Phillips and Hayman (1970). Root colonization of AM was observed under microscope (figure 1). Root slide technique (Read et al., 1976) was used to estimate the percentage of AM infection. The following formula was used to determine the Mycorrhizal colonization.

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\text{Percent colonization} = \frac{\text{Total number of root segments colonized}}{\text{Total number of root segments examined}} \times 100
\]

Fifty grams of Rhizospheric soil samples of individual plants within the species were mixed with one part which is used for AM Fungal spore enumeration. Wet sieving and decanting method (Gerdemann and Nicolson, 1963) was used to recover the AM Fungal spores. AM- Fungal spores (Figure 1) were mounted in polyvinyl alcohol Lactophenol and identified using Schenk and Perez’s manual (1990).

RESULTS AND DISCUSSION

The list of twelve ornamental plants associated with AM Fungi in Parul University garden showing percentage of root colonization(figure 1), spore number and AM fungal genera are represented in Table 1, Figure 2. The soil investigated in this study is sandy loamy soil and they formed good habitats for AM Fungal colonization. Four genus of AM Fungi were isolated, identified and were found associated with 12 ornamental plants soil samples belongs to 12 different families (Table 1, Figure 2) were collected from different localities of Parul university garden. This shows that all the 12
ornamental plants are found to be colonized by AMF. In the present work, the association of VAM in ornamental plants, the percent of colonization and number of spores showed no correlation (Figure 2). Lower percentage of colonization was recorded among members of Amaranthaceae that is in little Ruby (Alternanthera dentata- 12%). Moderately colonized plants possess 65%-67% among members of Portulacaceae (Portulaca grandiflora) and Asparagaceae (Chlorophytum comosum). However, highest colonization was recorded among members of Amaryllidaceae (Crinum asiaticum- 99.4 %) (Table 1, Figure 2). The colonization found in roots of different plants are of Hypha and vesicular type. In all the tested plants Hypheae were found common.

Physiologically and morphologically all the fungi are not the same. These Fungi are not specific in their effect on host species in spite of having wide host range. On cultivars, their effect can vary within a single plant species and also on plants in different eco system, similar soils and soil type’s change in their physico-chemical constituents. In soil, Arbuscular Mycorrhizal fungal spores are physiologically inactive. The spores germinate, grows and multiply in the presence of actively growing plant roots (Tommerup and Briggs, 1988).

Similarly, more number of spores (92/50gms of soil) was recorded in rhizosphere soil of petunia atkinsiana. Glomus species predominated in the Rhizosphere soil supporting ornamental plants followed by Acaulospora, Scutellospora and Gigaspora were considered to be the least spore genera among the isolated spore genera (Table 1). AMF genera with high number is associated with ixora coccinea while AM Fungal genera with low number is recorded in other remaining plant species.

Increased growth of seedlings of plantation crops like Cashew was observed when inoculated with AM Fungi (Lakshmipathy et al., 2000). It’s observed that in AM inoculated plants there is increased number of flowers and cut flowers’ vase life of Chrysanthemum and China Asters (Bagyaraj and Mallesh 2000). More rootings in Tamarindus and Cashew plants propagated through air layering was reported (Bagyaraj and Mallesh 2000). AM inoculated Avocado and Cashew plants withstood transplant shock better than uninoculated stock (Menge et al 1980, Lakshmipathy et al 2004). The result obtained from the investigation for the present study suggests that the number of AM fungal spores and colonization percentage vary with different ornamental plants. Glomus spp genera is frequently found more than other four genera. More number of Mycorrhizal spores in rhizospheric soil and AM fungal infection is found in the roots of Petunia atkinsiana and Crinum asiaticum, shows that under natural conditions these plant species are considered as a good host for AMF. Hence it can be concluded that distribution or occurrence of Arbuscular Mycorrhizal Fungi differ with host ranges. However population, size, shape of spores and percentage of root colonization differs from plant to plant. This study provides an AM fungi association with ornamental plants and it is an indication of Mycorrhizal dependency of these plants.

Table 1: List of Ornamental Plants Associated with Am Fungi in Parul University Garden Showing Percentage of Root Colonization, Spore Number and AM Fungal Genera

| Sl No | Name of the Plants | Common Name | Family | Percentage of Root Colonization (%) | Spore Number/50gm of Soil | AM Fungal Genera |
|-------|--------------------|-------------|--------|------------------------------------|-------------------------|-----------------|
| 1     | Rosa hybrid L.     | Tea rose    | Rosacea | 54.1 %                             | 63                      | Gl, Ac spp      |
| 2     | Madagascar periwinkle (L.)Rchb.ex Spach | Vinca | Apocynaceae | 52.4 %                             | 80                      | Gl, Sc spp      |
| 3     | Bougainvillea spectabilis Wild | Paper flower | Nyctaginaceae | 46 %                               | 76                      | Gl, Ac spp      |
| 4     | Crinum asiaticum   | Poison bulb | Amaryllidaceae | 99.4 %                             | 52                      | Gl, Gi spp      |
| L. | Name | Genus | Family | Root Colonization | AM Fungal Genera |
|----|------|-------|--------|-------------------|------------------|
| 5  | *Alternanthera dentate* (Moench) Stuchlik | Little ruby | Amaranthaceae | 12 % | Gl, Ac spp |
| 6  | *Ixora coccinea* L. | Westindian jasmine | Rubiaceae | 44 % | Gl, Ac, Sc spp |
| 7  | *Hibiscus rosa-sinensis* L. | Chinese hibiscus | Malvaceae | 45.8 % | Gl, Sc spp |
| 8  | *Portulaca grandiflora* Hook. | China rose | Portulacaceae | 65 % | Gl, Ac spp |
| 9  | *Chlorophytum comosum* (Thunb.) Jacques | Spider plant | Asparagaceae | 67 % | Gl, Sc spp |
| 10 | *Jasminum sambac* (L.) Aiton | Mogra | Oleaceae | 48.9 % | Gl, Gi spp |
| 11 | *Petunia atkinsiana* (Sweet) D.Don ex W.H. Baxter | Garden petunia | Solanaceae | 75 % | Gl, Ac spp |
| 12 | *Sphagneticola trilobata* (L.) Pruski | Trailing daisy | Asteraceae | 84.4 % | Gl, Sc spp |

- Names of four AM fungal genera - Gl- Glomus spp, Ac- Acaulospora, Sc- Scutellospora and Gi- Gigaspora spp.

Root colonization of *Sphagneticola Trilobata* (X450)

Root colonization of *Crinum asiaticum* (X 100)
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Figure 1: The Root Colonization and Some AM Fungal Spores Associated with Ornamental Plants.

Root Colonization of Portulaca Grandiflora (x 100)

Glomus spp

Acaulospora spp

Scutellospora spp

Gigaspora spp
Figure 2: 12 Ornamental Plants Associated with Am Fungi Showing Percentage of Root Colonization & Spore Numbers

Key:

Rh - Rosa hybrid  
Hr - Hibiscusrosasinensis

Mp - Madagascar periwinkle  
Pg - Portulaca grandiflora

Bs - Bougainvillea spectabilis  
Cc - Chlorophytum comosum

Ca - Crinum asiaticum  
Js - Jasminumsambac

Ad - Alternanthera dentate  
Pa - Petunia atkinsiana

Ic - Ixora coccinea  
St - Sphagnicolatrilobata
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