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Effect of Seasonal Variation and Edaphic Factors on am Population Associated With Medicinal Plants of Hardwar Range of Rajaji National Park, Uttarakhand

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ABSTRACT:

"Mycorrhiza" – mark out a symbiotic association between a fungus and roots of the host plant, in which both are getting advantage. This association has importance in terms of growth, yield, nutrition, protection and biochemical contents of the host plant. These are omnipresent and fall under a broad ecological range. An investigation has been made to examine the spore density and root colonization of Arbuscular Mycorrhizal Fungi (AMF) in the rhizosphere of *Syzygium cumini and Atlantis monophylla* collected from Hardwar range of Rajaji National Park, Uttarakhand, India. The spore density ranges from 30-68/10gm and 46-345/10gm of soil whereas percent root colonization ranges from 30-70% and 20-80% for *Syzygium cumini and Atlantis monophylla* respectively. Maximum spore count and percent root colonization was recorded in rainy season and minimum was recorded in winter season. Six species were isolated, which belongs to genus *Glomus* and *Acaulospora*. *Glomus* was found to be predominant over *Acaluospora*. The edaphic factors were also analysed and correlated with the diversity measures.

KEYWORDS: Mycorrhiza, Symbiotic, Rhizosphere, *Glomus*, *Acaluospora*, Edhaphic.

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INTRODUCTION-

AM fungal spores multiply only in association with plant roots which act as a suitable ecological niche for germination of spores. Soil properties like texture, pH, moisture content, organic matter and phosphorus contents can be measured or determined and is used to characterise the soil inhabitant by a particular type of micro flora and fauna. Medicinal plants are a rich source of ingredients that are frequently used for drug synthesis. The World Health Organization (WHO) estimated that 80% of the population of developing countries relies on traditional medicines, mostly plant drugs, for their primary health care needs[1]. Because of the growing pressure of pharmaceutical industries, medicinal plants are being tilled. One fifth of all the plants in India are used for medicinal purpose. Majority of plants have the dynamic association with AM fungi. AM/VAM fungi occur in 80% of vascular plants[2]. AM fungi is a type of mycorrhiza, where the fungus resides in the cortical cells of the roots of the plant. They form unique structures viz. arbuscules and vesicles. It helps the plant to absorb nutrients from the soil. AM helps in the taking up of P and other nutrients from in sufficient area through fungal hyphae by expanding the root absorption area. AM fungi helps in soil conservation by making cluster of soil with the help of hyphal networks. AM hyphae can take up nutrients up to 12 cm from the surface of roots[3]. AM shows symbiotic relationship with the plants, which is the most common symbiosis. Symbiosis represents a mutual connection between two different living beings[4] in which both plant and fungus are complementary to each other. The conditions and growth of medicinal plants is improved by inoculation of AM in the root system. AM fungi associated with medicinal plants has not only enhanced the growth of these plants but also improved the active principle content[5-6].

EXPERIMENTAL SECTION

Most of the soil samples were collected from the rhizospheric soil of *Syzygium cumini* and *Atlantia monophylla* for the present study. Soil, a natural home for various microbes which maintains a dynamic equilibrium and its properties such as pH, phosphorus, organic carbon etc. has been determined as the distribution and occurrence of AM fungi vary with the change in edaphic factors. The objective of this study is to find out the species diversity of AM fungi in rhizospheric soil with different physiochemical properties.

Study site- Studies on arbuscular mycorrhizal fungi of rhizospheric soil were carried out on medicinal plants, collected from Hardwar range of Rajaji National Park, Uttarakhand India. It is located at an altitude of 302-1000m asl and falls under sub tropical moist deciduous forest type.

Soil sample collection- Soil and root samples were collected from the site using soil auger at a depth of 5-15cm. It is stored at room temperature for further analysis.

Study of root colonization – Roots were washed and cut into 1cm pieces in length for determination of percent mycorrhizal colonization[7].

$$\%\, root\ colonization = \frac{\text{Total number of roots segmants colonized}}{\text{Total number of roots segments examined}} \times 100$$

Isolation and identification of AM fungi- 10 gm of rhizospheric soil samples were analysed for spore isolation by wet sieving and decanting technique[8]. The isolated AM spores were identified on morphological basis with help of monograph given by Schenck and Perez[9] and INVAM (http://www.invam.caf.wvu.edu).

Physiochemical analysis of soil samples- As the AM fungi was influenced by soil parameters, physiochemical analysis of soil samples were also done.

Soil pH- 1 gm of soil is dissolved in 10ml of DW to make a suspension. Further, the supernatant was taken and the pH of the soil was measured using pH meter.

Chemical properties- Soil organic carbon[10]; Phosphorus[11] and Potassium[12]were determined.

Statistical analysis –Spore density and root colonization were measured. Pearson's correlation coefficient was used to assess the relationship between diversity measures and edaphic factors.

RESULT AND DISCUSSION-

During the present investigation, AM fungal spores were found to be well distributed in all soil samples analysed as well as roots studied for root colonization although their types and number varied considerably. Both medicinal plants showed varied number of spores (Table 1).

Table 1. Soil parameters in test plants

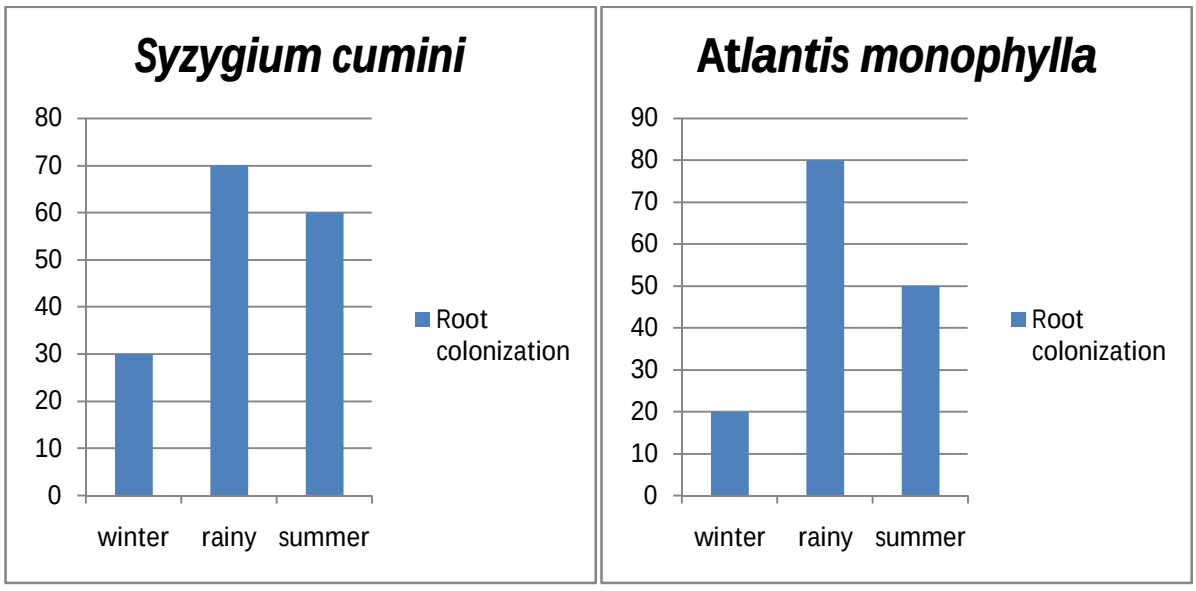
Plant species	Season	Spore count	% Root colonization	pH	O.C	P	K
Syzygium cumini	Winter	30±7.72	30%	6.9±0.26	0.06±0.02	14±2.51	119±3
	Rainy	68±7.54	70%	7.4±0.30	0.57±0.03	8.7±2.51	155±2.04
	Summer	42±7.63	60%	6.9±0.25	0.70±0.02	13.5±2.6	310±3
Atlantis monophylla	Winter	46±5.56	20%	6.9±0.26	0.09±0.02	9±2.51	121±3.05
	Rainy	345±10.96	80%	7.2±0.25	0.64±0.03	13.8±2.31	178.9±3.63
	summer	147±4.50	50%	7±0.3	0.51±0.02	19.7±2.08	192.9±4.11

During present study, spore population ranges from 30-68 in *Syzygium* and 46-345 in *Atlantia*. Percent root colonization ranged from 30-70% in *Syzygium* and 20-80% in *Atlantia* respectively (Fig.1 a, b). Rhizospheric soil samples were processed and number of AM spores/10 gm of soil were assessed which range from 30-345. *Atlantia* showed high spore count as compared to *Syzygium* in all seasons. 6 species belonging to two genera namely *Glomus* and *Acaluospora* were observed (Fig. 3). *Glomus* was found to be the most dominant species but *Acaluospora* species abundance were also evident. Table 1 depicts soil pH, organic carbon, phosphorus and potassium

showing effect on spore population and root colonization. In case of *Syzygium*, it is evident that the soil pH ranges from 6.9-7.4 and shares a strong positive relation with spore count and percent root colonization. The O.C content ranges from 0.06-0.70 and shares a strong positive correlation with both spore count and root colonization. Phosphorus and potassium shares a strong negative correlation with both measures whereas *Atlantia* study revealed its pH range from 6.-7.2. O.C content was negatively correlated with spore count and positively correlated with root colonization. Potassium and phosphorus shares a positive correlation with spore count and a negative correlation with root colonization. Correlation values of soil properties with respect to spore count and root are calculated. The spore density and root colonization of both plants are highly correlated (Table 2).

Table 2. Correlation between different parameters of test plants

	pH	O.C	P	K
Syzygium cumini-spore count	0.951101277	0.6006086	-0.97401213	-0.6312796
Atlantis monophylla-spore count	-0.9829076	-0.042922105	0.725875048	0.34746562
Syzygium cumini percent colonization	0.69337524	0.90648412	-0.752400317	-0.443351699
Atlantis monophylla percent colonization	0.65465367	0.226118305	-0.586839577	-0.16889784



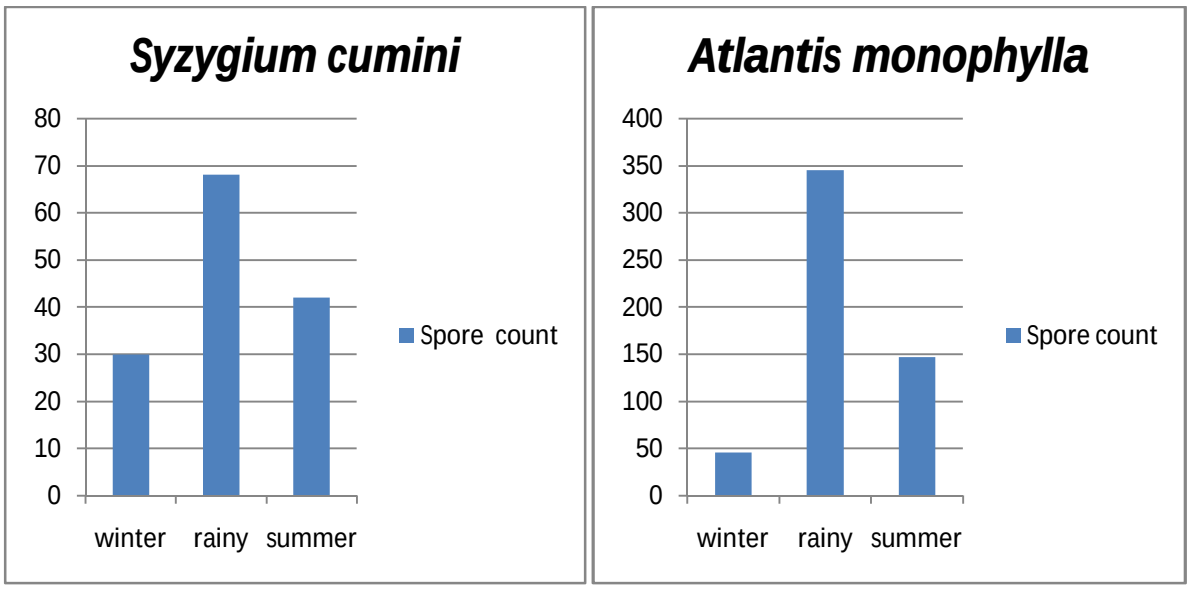


Fig. 1 Seasonal variation in test plants

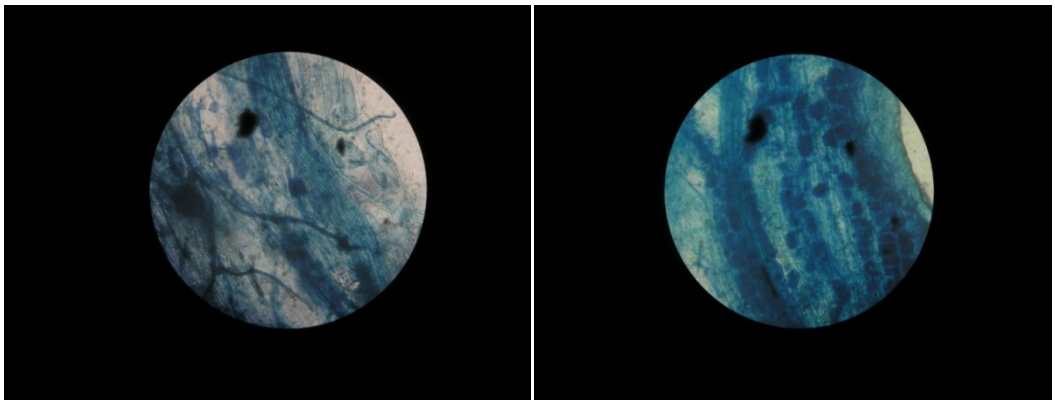
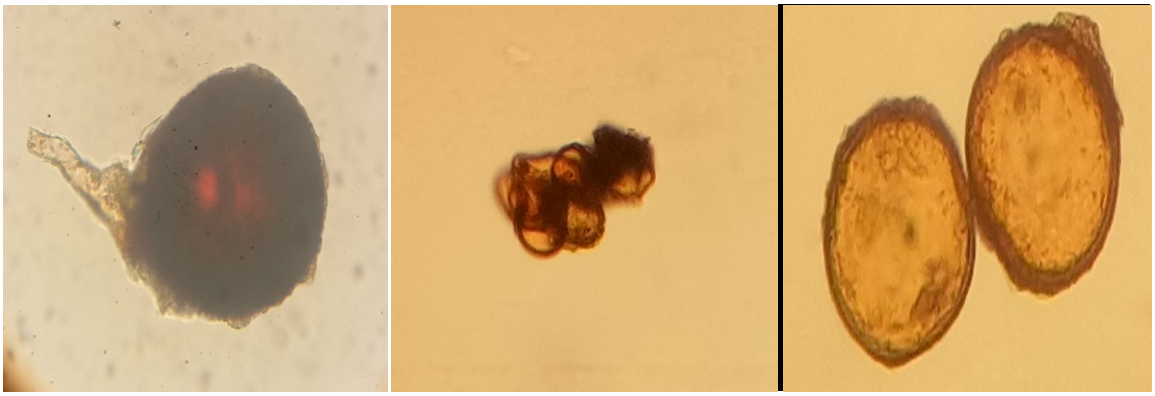


Fig. 2 Root colonization by AMF spores



Glomus fasciculatam *Glomus fasciculatum* *Acaluospora mella*

Fig. 3- Isolated spores from rhizospheric soil

Soil is a constantly changing medium activated by the interplay of a vast variety of macroscopic and microscopic forms of life. AM fungi have a widespread distribution throughout the plant kingdom and the association of fungi is geographically ubiquitous. The extent of root

colonization and spore number is the criteria for determining AM diversity and richness. AM has directly effect on structure and diversity of plant species. In the present study, spore population ranges from 30-68 in *Syzygium* and 46-345 in *Atlantia*. Also, the percent root colonization range from 30-70 in *Syzygium* and 20-80 in *Atlantia*. *Glomus* was the predominant species followed by *Acaluospora*. Both plant shows high spore density in rainy season followed by summer and winter. Root colonization also shows the same pattern -high in rainy season, moderate in summer season and lowest in winter. These results are in agreements with the earlier reports[13-17]. The predominant species is *Glomus* which is related with earlier observations[18-21]. Soil factors directly affect the mycorrhizal population. pH shares a positive correlation with *Syzygium* and negative with *Atlantia* which are related to Wang *et al.* [22-23]. AM spores increase with increasing organic carbon which are in accordance with Johnston[24]. Phosphorus is negatively correlated with both plants which are in agreements with Javadi *et al.* [25] .Potassium also shows negative correlation which are related to Khanam *et al.*.[26].

CONCLUSION

AM fungi are present in soil in the form of both sexual and asexual spores i.e. zygospores, azygospores and chlamydospores and also in the form of hyphae and vesicles associated with plant roots. Each of these forms remains dormant in soil till they find a suitable host for growth and reproduction. During the present study, the AM fungi revealed very extensive role for understanding the dynamics of these fungi in soil. As per the result of present study, it can be concluded that both seasons and soil parameters affects the AM spore density. Rainy season is given preference as compare to winter and summer in case of spore count and root colonization but we can't neglect the environmental factors like pH, O.C etc.

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