SEASONAL DIVERSITY OF AMF IN MOTICHUR RANGE OF RAJAJI NATIONAL PARK, UTTARAKHAND

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Abstract : Two medicinal plants i.e. *Adhatoda vasica* and *Agretum conyzoides* were studied for AM association . Both plants shows AM fungi and root colonization. *Glomus* was found to be predominant , followed by *Acaluospora.* 10gm of soil shows 287 spore count (*Ageratum*) and 228 spore count (*Adhatoda*) in rainy season. Root colonization was 100 % in both plants in rainy season .The physiochemical properties were also discussed with respect to spore distribution and root colonization.

IndexTerms **- AM fungi, *Glomus*, Medicinal , Physiochemical.**

I. INTRODUCTION

Mycorrhizal fungi, a group of soil microorganisms that are ubiquitous in nature, shares a symbiotic relation with roots of majority of terrestrial plant species either intercellulary or extracellulary. Endomycorrhiza form specific fungal formation namely vesicles and arbuscules inter and intracellularly, thus giving it a special name, VAM (Choudhary *et al.*, 2014). AM is found in all agronomic, medicinal plants and vegetable crops. They are symbiotic soil fungi which colonize the roots of approximately 80 % of plant families(Harley and Harley ,1987). They impart to their host a variety of benefits which include increased growth and yield due to enhanced nutrient acquisition , water relations, pH tolerance and disease and pest resistance (Diedrichs and Moarrhel, 1993; Mosse,1973; Davies *et al.*, 1993; Subramanian *et al.*, 1995; Clark and Zeto, 1996; Maddox and Soilean, 1991; Lopez *et al.*, 1997; Trotta *et al.*, 1996).VAM enhances specially phosphorus and other elements (N, K, Zn, Ca, Mg) uptake. It gives protection from various stress and root pathogens. Mycorrhizae is present in 83% of dicots and 79% of monocots(Sharif and Moawad, 2006). AM fungi association with plants increase its growth as well as its active principle contents. The main benefit of AM is the augementation of perforation zone of root system. The AMF hyphal network perform as an extra assimilating organ in the soil(Sharma and Adholeya, 2004). The mycorrhizal roots are more efficient than the non mycorrhizal roots because of the active uptake of the nutrients (Phiri *et al.*, 2003; Jamal *et al.*, 2002). Mycorrhiza can enhance the grade and amount of compounds obtained from medicinal plants in lesser time (Karthikayan *et al.*, 2009). The non-nutritional benefits of AM association include improved water relation, increased resistance to root pathogens, mineral element toxicity and stable soil structure (Turk *et al.*, 2006). VAM fungus diversity determines plant community structure and overall ecosystem stability and function (Heijden *et al.*, 1998). The collection area under present study is Motichur range of Rajaji National Park, Uttarakhand, India. It is spread over 820 km ^{2} under three districts- Haridwar, Dehradun and Pauri Garhwal. In Motichur range, a rich vegetational cover is present due to abundant rainfall. Plant species , soil parameters and seasonality all influences the AM fungi diversity. Plants have been used medicinal purpose for a long time. *Ageratum conyzoides* and *Adhatoda vasica* were chosen for study. *Ageratum* have medicinal value as analgesic, antibacterial, anti-inflammatory, purgative and antilithic. *Adhatoda* is used to cure respiratory disorders, cough , pyorrhoea and skin ailments. Hence a study has been conducted to observe AM fungi associated with targeted plants. The correlation between spore density and edhaphic factors were also investigated.

II. RESEARCH METHODOLOGY

Study site-The present research work has been done with soil samples collected from Motichur range of Rajaji National Park from the rhizosphere of two medicinal plants i.e. *Adhatoda vasica* and *Ageratum conyzoides.*

Collection of soil and root samples-Rhizospheric soil samples were collected at a depth of 5-15cm. These were air dried at room temperature and stored in polythene bags for isolation of spores.

Root colonization and spore isolation –The technique of Phillips and Hayman (1970) were used for determining the AM infection in roots and spores were extracted by wet sieving and decanting technique(Gerdemann and Nicolson, 1963). Identification of AM spores were done by manual(Schenck and Perez, 1989) and INVAM((http://www.invam.caf.wvu.edu).

Estimation of edhaphic factors-The soil pH was determined by using pH meter. Various chemical properties such as Organic carbon (Walkley and Black 1934), Phosphorus (Olesen *et al*., 1954) and Potassium (Hanway and Haidal, 1952) were also determined. Pearson's correlation was used for statistical analysis of spore density and edhaphic factors.

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III. RESULTS AND DISCUSSION

It is evidenced from the results (Table 1) that % root colonization was present in both test plants which ranges from 40-100%.

Table 1 Percent root colonization, rhizospheric spore population and soil parameters in test plants

Plant species	Season	Spore count	% Root	pH	O.C	P	K
Adhatoda vasica	Winter	43 ±2.38	40%	7.3±0.20	0.08±0.03	9±3	109±2.51
	Rainy	228 ±3.00	100%	6.6±0.26	0.41±0.01	13.7±2.27	181±2.04
	Summer	84 ±4.58	60%	6.9±0.20	0.72±0.02	13.1±2.40	234±2.08
Ageratum conezyoids	Winter	47±7.62	40%	7.5±0.20	0.12±0.02	11±4.04	106±1.52
	Rainy	287±3.60	100%	7.2±0.10	0.73±0.02	18.3±3.51	150±2.64
	summer	89±4.00	80%	7.0±0.30	0.61±0.48	18±3.0	198±1.52

Highest root colonization was found in rainy season(100%), moderate in summer(60%) and low in winter(40%). Spore count per 10 gm of soil in *Adhatoda vasica* was highest in rainy season (228) followed by summer(84) and winter(43). 5 species belonging to two genera – *Glomus* and *Acaluospora* were isolated. *Glomus* was dominant followed by *Acaluospora* (Fig. 1, 2). Imn case of test plant *Ageratum conezyoides*, maximum root colonization was found in rainy season(100%) and minimum in winter(40%). Spore count per 10gm of soil were following the same trend i.e maximum(287) in rainy season and minimum in winter(47).5 species belongs to two genera were examined(Fig. 3). *Glomus* was predominant but *Acaluospora* has also moderate density. It is imperative from the results that both plants possess AM spores and % root colonization which shows seasonal variance. *Glomus* was predominant in both plants and in all seasons. Rainy season was the best for the growth of spores and colonization of roots. These results are in agreements with the previous reports (Kumar *et al.*, 2013 ; Khamar Jahan *et al.*, 2012; Chanda *et al.*, 2014; Bukhari *et al.*, 2003; Mosse, 1973). Study of soil parameters had revealed that there is variation in edhaphic conditions. Both plants show negative correlation with pH in terms of spore density and root colonization (Table 2).The pH of both soil are neutral in conditions. Organic carbon contents range from 0.08-0.73 for both plants which are positively correlated with %root and spore count. Potassium and phosphorus shares a positive correlation with %root and spore count in both plants which depicts that increase in a single variable resulted in increase in AM population. The phosphorus value was higher in monsoon season whereas the potassium value was higher in summer season. Potassium content was positively correlated which denied the negative correlation shown by Khanam *et al.*(2006). In most of the findings, phosphorus is negatively correlated (Javadi *et al.*, 199; Graham *et al.*, 1981; Ratanayake *et al.*, 1978) but in our results, it shows strong and positive correlation .VAM fungal spores increases with increases in organic carbon which is in accordance with Gaur and Kaushik(2011b).

Table 2. Correlation between Percent root colonization, rhizospheric spore population and soil parameters in test plants

	pH	O.C	P	K
Adhatoda vasica spore count	-0.923647755	0.228588021	0.753740539	0.295634663
Ageratum conezyoides spore count	-0.275918923	0.7675004	0.66276426	0.1390358
Adhatoda vasica root colonization	-0.963123137	0.344319071	0.82748963	0.50867896
Ageratum conezyoides root colonization	-0.731043470	0.98925534	0.956174132	0.63547802

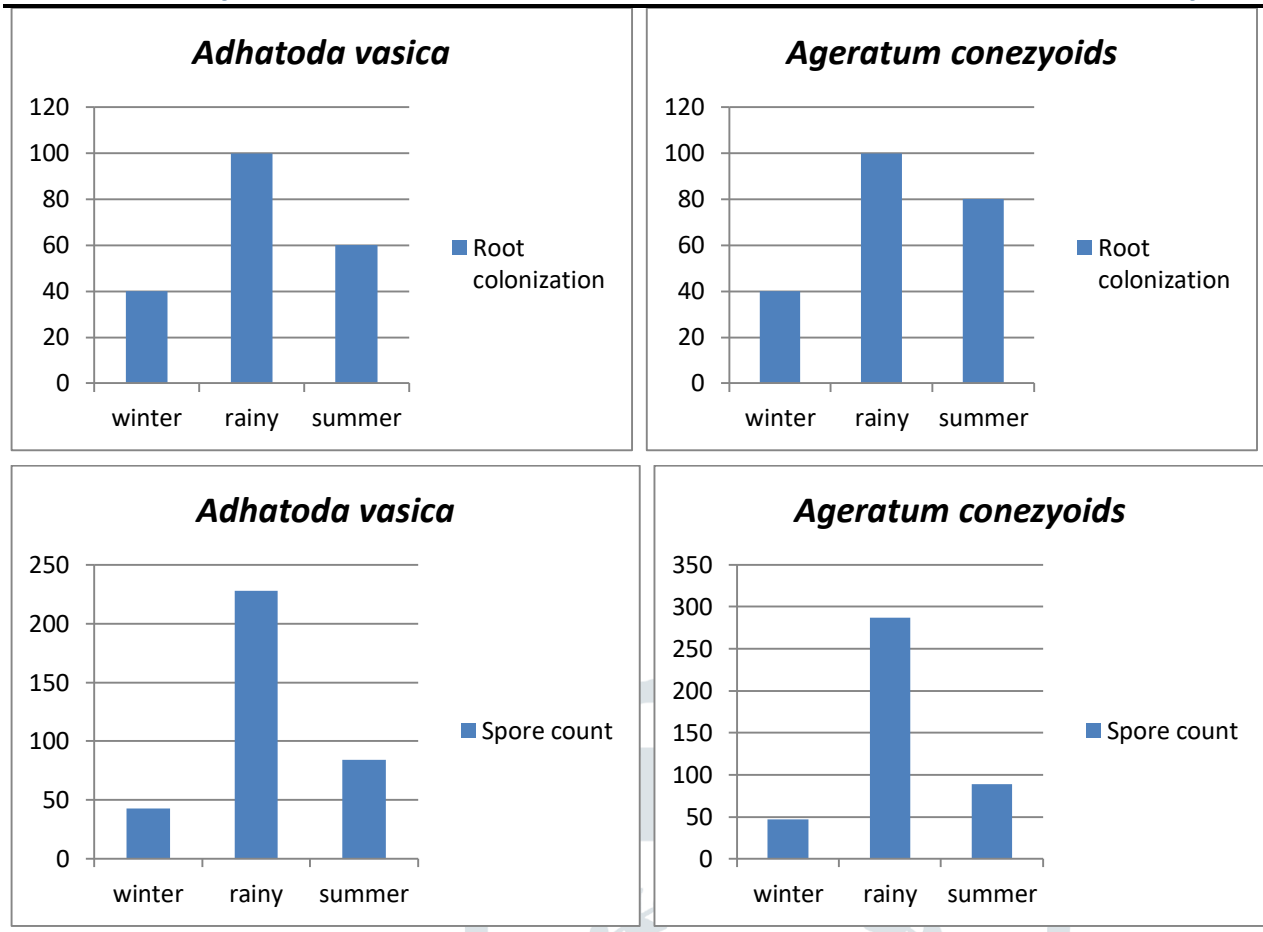

Fig. 1 – Seasonal variation in root colonization and spore count of test plants a) *Adhatoda vasica b) Ageratum conyzoides*

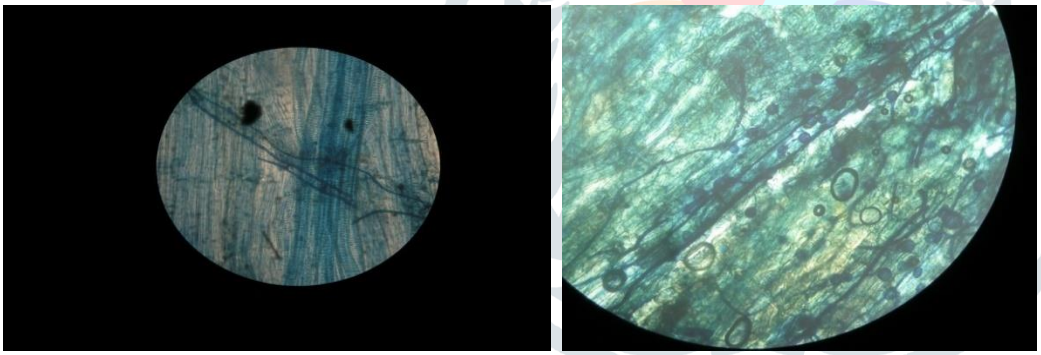

Fig. 2 Root colonization by AMF spores

Glomus fasciculatam *Glomus fasciculatam* *Acaluopsora foveata* *Glomus fasciculatam*

Fig. 3- Isolated spores from rhizospheric soil

IV. CONCLUSION

This study showed good AM spore density and root colonization .Both are effected with various edhaphic factors. Type of vegetation also shows difference to it. pH, organic carbon, phosphorus and potassium were analysed and correlated with spore population. All parameters shows positive correlation inspite of pH which shows negative correlation. Seasonal studies also shows the conditions for AM spore number and %root colonization. Rainy season is preferred over winter and summer season. Type of vegetation are important factors for determining the spore number and species but edhaphic factors also can't be ignored. AM fungi have great potential utility in plant production . The most common beneficial effect of mycorrhizae is increased uptake of immobile nutrients, notably P from soil.

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