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Fluctuations in Arbuscular Mycorrhizal Population with Seasons in Rhizosphere of Mulberry Gardens of Kashmir

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ABSTRACT

Mulberry (Morus sp.), a perennial heterozygous plant is the sole source of food to silkworm (Bombyx mori L) and can be grown in diverse climatic conditions. However, it is grown abundantly in Kashmir but the soils are low in available nutrients which cause their deficiency limiting the mulberry growth both qualitatively and quantitatively. Inspite of this, the plant produces more biomass as against the other tree species growing in the region. It seems that the litter decomposition is the main source of nutrients to this plant by means of microbial processes in soil. The environmental factors along with some basic characteristics of host plant play a dominant role in distribution of these microbes. Therefore, the present study was undertaken to know the availability of Arbuscular Mycorrhizal spore population with respect to seasons and the results of the study revealed highest population of arbuscular mycorrhizal fungi in spring season, which was moderate in winter followed by autumn season and lowest in summer season. The reasons for seasonal fluctuations may be due to several factors such as soil temperature, moisture, organic carbon status, pH, nutrient status of soil, host cultivar type, etc.

***Keywords**: - Arbuscular mycorrhiza, fluctuations, Mulberry, rhizosphere, seasons.*

I. INTRODUCTION

Mulberry (*Morus* sp. perennial heterozygous plant) a sole source of food to silkworm (*Bombyx mori* L) is grown in diverse climatic conditions. It is grown abundantly in Kashmir but the soils are low in available nutrients which cause their deficiency limiting the mulberry growth both qualitatively and quantitatively. Inspite of this, the plant produces more biomass as against the other tree species growing in the region. It seems that the litter decomposition is the main source of nutrients to this plant by means of microbial processes in soil. In addition the environmental factors have a direct/dominant effect [1] but they may also have an indirect effect through interactions with other factors such as vegetation, topography, etc in distribution of these microbes [2].

It is well established that symbiosis between soil fungi and plant roots play a key role in plant productivity. More than 80 percent of all the land plants have a mutualistic relationship with one or more mycorrhizal fungi [3]. Arbuscular mycorrhiza is the commonest type of mycorrhizal association since they are formed by about four-fifths of all terrestrial plants [4], although they have been also found on the roots of some trees. Mycorrhizal fungi extend the effective root length by 100 fold or more by spreading the mycorrhizal network through Hartig's net. Not only do they increase the surface area over which nutrients and water can be taken up by the plant, but fungal hyphae can penetrate the smaller pores than roots can, there by protect the plants under mild drought stress and also help to deter the activity of root pathogens. The most valuable/important benefit of mycorrhizae is that it provides access to immobile nutrients, such as phosphorous [5]. Arbuscular mycorrhizal (AM) fungi are important in ecological agriculture because they provide benefits for majority of cultivars and the conservation of the environment by acting as biofertilizers, bioprotectors and biocontrol agents [6]. Arbuscular mycorrhiza is also referred to as endo mycorrhiza because it has a branched arbuscule that grows within the root cortical cell. AM fungal symbiosis is generally characterized by rapid and frequent colonization of new roots and the appearance of vesicles in the oldest colonizing units [7]. This fungal symbiosis significantly improves plant nutrition under low fertility soils due to more efficient mycorrhizal hyphal network than roots alone in nutrient uptake especially of the elements with low mobility. However, as far as the mulberry tree is concerned, several studies have been conducted about the presence of different species of fungi i,e. arbuscular mycorrhiza in various mulberry growing soils in India .But no information is available about the native population of arbuscular mycorrhiza inhabiting the mulberry rhizosphere in various seasons. Therefore, the present study was undertaken to know the arbuscular mycorrhizal population in various seasons so that they can be mass multiplied and put to use in the management of soil fertility.

II. M ATERIALS AND METHODS

The study entitled, "Fluctuations in Arbuscular Mycorrhizal Population with Seasons in Rhizosphere of Mulberry Gardens of Kashmir" was conducted at Biofertilizer Research Laboratory, Faculty of Agriculture (FOA), Wadoora, SKUAST-K as per the following experimental details:

2.1 Experimental Details:

1. Regions : 03 (North, Central and South).
2. Number of locations : 03 from each region.
3. Location names : North (Mirgund, Manasbal & Bandipora)

a. : Central (Poohu, Galander & Srinagar).

b. : South (Y.K. pora, Krungsoo & Bijbehara).

4. Samples per location : 05 (Composite).
5. Seasons : 04 (Spring, Summer, Autumn, Winter).

- Spring →1st week of April.
- Summer →1st week of July.
- Autumn →1st week of October.
- Winter →1st week of January.

6. Design of survey : Purposive sampling.

2.2 Soil Sampling

Soil samples were collected during spring (1st week of April), summer (1st week of July), autumn (1st week of October) and winter (1st week of January) seasons from 9 different mulberry farms of Kashmir valley. Rhizosphere soil samples were taken from the soil adhering to the roots of mulberry in sterilized polythene bags to prevent moisture loss and as soon as possible were refrigerated to avoid microbial fluctuations. From each location, during each season, five samples were collected during January to December to minimize the effect of inherent site variability. Thus a total of 180 samples were collected in all the four seasons and brought to the laboratory for further analysis of AM as follows:

The samples were subjected to wet sieving and decanting method [8] for isolation and enumeration of Arbuscular Mycorrhizae (spores/g soil) to observe the effect of different seasons on AM fungal population.

2.3. Isolation of Arbuscular Mycorrhiza

Wet sieving and Decanting technique is used to remove the clay and sand fractions of the soil while retaining spores and other similar sized soil and organic matter particles on sieves of various diameters.

In this method, 100g of rhizosphere soil was suspended in half liter of water (1/2 liter) in a 500 ml beaker, and was stirred vigorously to detach soil debris in order to make a uniform soil suspension and to dissolve the lumps if any. The beaker was then left undisturbed for 2- 5 minutes. After 5 minutes, spores were collected by pouring the prepared soil in the same position (from beaker) on to a series of sieves (No.1=250µm, No.2=200µm, No.3= 100µm, No.4= 50µm in size) superimposed one upon the other with the smallest pore size placed at the bottom of the sieve and vice versa.

After pouring soil through the 1st compartment i.e. 250µm sieve to screen out larger debris, water got drained/ sieved through the subsequent sieves below the 1st sieve. The first three sieves i,e. 250µm, 200µm, 100µm were then removed. The collected soil solution in bottom sieve (4th sieve no.) with fine pores was again sieved under a gentle stream of water and washed abundantly to remove the traces of soil for more clear identification of Arbuscular Mycorrhizal spores,. The number of sieves can be reduced or increased according to texture of soil. However, over flooding of finest sieves was avoided as many small diameter spores could be lost. Fifteen (15) ml of clear supernatant was retained in a beaker and taken in a micro Petri plate for observation of Arbuscular Mycorrhizal spores directly under binocular microscope. AM of varying colours and shapes were observed and then the counting of number of Arbuscular Mycorrhizal (AM) spores was done. The total AM spores (live and dead) were added up for final counting (plate 1).

III. RESULTS

Observations recorded in different locations of mulberry gardens in Kashmir revealed that arbuscular mycorrhiza were maximum (10.46) during spring season and statistically significant over other regions ranging from 6.08 in summer to 8.48 in winter. Among the regions, central region though registered the maximum value (8.38) for Vesicular Arbuscular Mycorrhiza, however, it was statistically at par with the other two regions which registered 7.93 and 7.73 respectively as shown in TABLE below:

Region / Season	North				Central				South				Over all mean
	Mirgund	Manasbal	Bandipora	Sub Mean	Poohu	Galander	Srinagar	Sub mean	Y.K. Pora	Krungsoo	Bijbehara	Sub mean	
Spring	9.40	10.20	8.40	9.33	9.40	14.40	10.00	11.26	8.80	14.80	8.80	10.80	10.46
Summer	5.40	7.40	6.20	6.33	6.00	7.20	5.20	6.13	6.60	5.00	5.80	5.80	6.08
Autumn	6.20	8.20	7.00	7.13	7.20	8.00	6.80	7.33	7.20	5.40	7.20	6.60	7.02
Winter	8.60	9.60	8.60	8.93	8.20	8.20	7.80	8.80	7.00	6.40	7.40	7.73	8.48
Mean	7.40	8.85	7.55	7.93	7.85	9.65	7.65	8.38	7.65	8.05	7.50	7.73	

C. D ($p \leq 0.05$)

Seasons : 0.65

Regions : N/S

Table : Seasonal variation in arbuscular mycorrhizal spore (spores/g soil) count of mulberry soils of Kashmir.

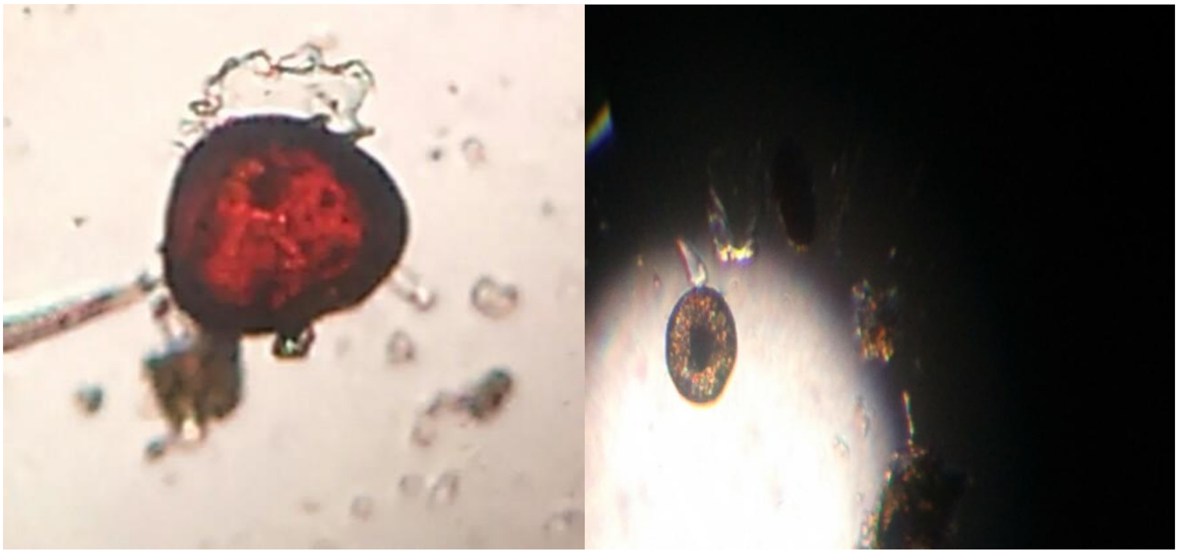
IV. DISCUSSION

The mulberry plant roots were found to be heavily colonized by AM fungi during the active growth period i,e. during spring season being the least during summer season . The maximum amount / abundance of arbuscular mycorrhizal spores during spring season and lowest in summer season in the rhizosphere soil of mulberry plants growing in different nurseries/gardens showed seasonal variation. These variations / fluctuations with respect to seasons may be attributed to/may be influenced by several factors like nutrient status of soil (organic matter content), climatic conditions (soil moisture, temperature), AM strains, soil pH, host cultivar, etc. Another reason for the increase of AM fungal population in the present study during growing season of foliage (i,e. spring) may be probably because of the support of process by energy substrates accumulated in the preceding growing season (i, e. during winter). During spring season, the rains are common in valley and temperature & moisture are maintained at optimum level which results in increased mineralization of organic matter through microbial decomposition in soil [9]. This results in lowering of pH which is favourable for the growth / multiplication of mycorrhiza. [3] while investigating the AM spores in rhizosphere of almond tree reported that the per cent AM fungal colonization was found less in summer, moderate in winter and highest in spring season .These findings are also in agreement with the findings of [10], who reported the highest number of AMF spore count was found in rainy season while moderate in winter and least in summer. **(Plate: 1-3).**

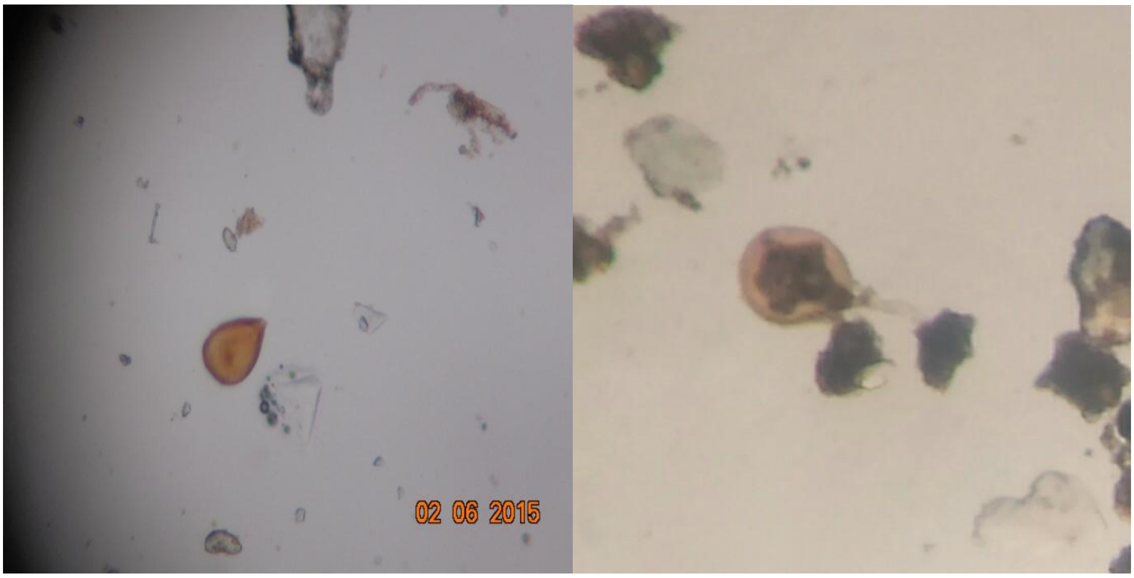
Moderate population of AM during autumn may be because of improved organic carbon (by the addition of leaves twigs, etc from the host plant) and optimum temperature of soil. However, the declining trend during the summer season in the AM population may be because organic carbon content decreases with increase in temperature [11].

The differences among the regions in the population of AM however, were non significant. This could be attributed to the host specific nature of arbuscular mycorrhiza. Particular microbial communities associate with specific plant species [12].Host plants have been found to have profound influence on the microbial population by secreating specific root exudates, as the microbes present must be able to tolerate/utilize the plant's exudates[13].This is in conformity with the findings of [14] who reported that AM fungal species differ across host species, generating distinct AM fungal community composition on different host plants.

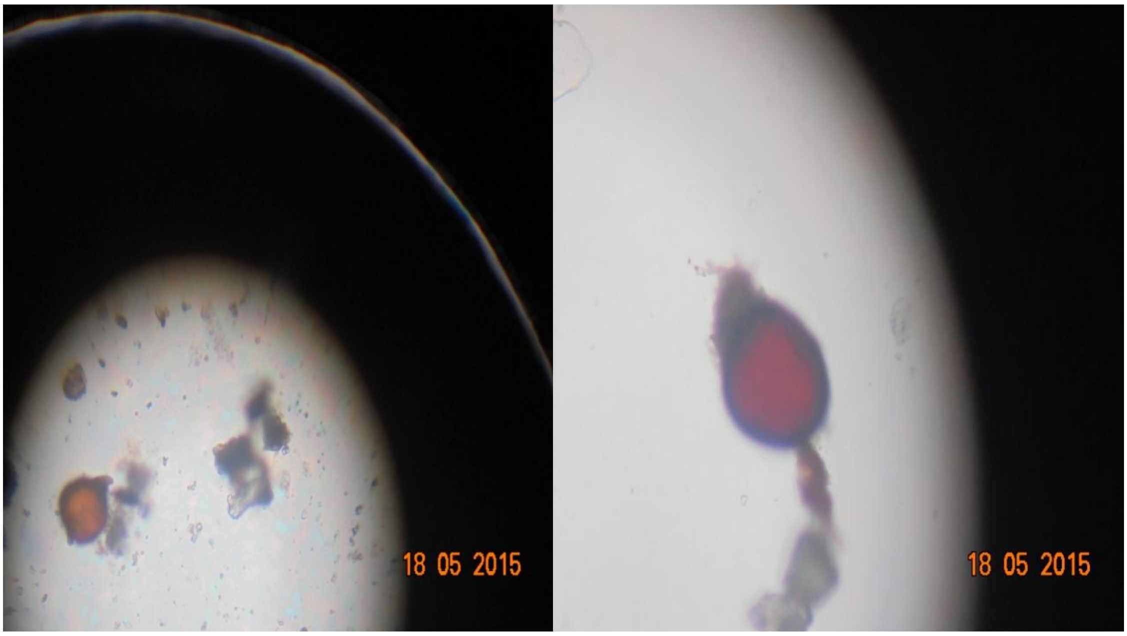
However, the study reflected a declining trend in the population of AM fungi with increase in altitude, it coincides with the fact that the flora richness and diversity also decrease with increase in geographical altitude [15].



(Plate – 1 Arbuscular mycorrhiza from soils of Central Kashmir)



(Plate – 2 Arbuscular mycorrhiza from soils of North Kashmir)



(Plate – 3 Arbuscular mycorrhiza from soils of South Kashmir)

V. CONCLUSION

The study entitled "Fluctuations in Arbuscular Mycorrhizal Population with Seasons in Rhizosphere of Mulberry Gardens of Kashmir" threw open some important findings . The study led to the fact that spring seems to be the most favourable season for the proliferation of arbuscular mycorrhiza (AM) thereby enhancing the soil health. In general, AM thrived well during spring and winter as compared to autumn and summer owing to favorable climatic conditions especially soil moisture, temperature, organic matter, etc prevailing during the seasons. AM were uniformly distributed throughout the regions of the Kashmir and the number of spores were minimum at higher altitudes (Y.K.pora, Krungsoo and Bijbehara Nutrient availability in the form of organic matter in the soil seems to have pronounced influence on the arbuscular mycorrhizal population in mulberry growing soils. Hence, arbuscular mycorrhiza could be supplied to the soil during the period of foliage growth and in this way help the plant at such a stage when it has a high demand for mineral nutrients.

VI. LITERATURE CITED

[1.] R.E. Ley, M.W. Williams, and S.K..Schmidt, Microbial population dynamics in an extreme environment: controlling factors in talus soils at 3750m in the Colorado Rocky Mountains, *Biogeochemistry*, *68*, 2004, 313-335.

[2.] S. Malchair, and M. Carnol, Microbial biomass and C & N transformations in forest floors under European beech, sessile oak, Norway spruce and Douglas-fir at four temperate forest sites, *Soil Biol. Biochem*., *41, 2009,* 831-839.

[3.] M.C. Hirrel, H. Mehravaran, and J.W.Gerdemann,, Vesicular mycorrhiza in theChenopodiaceae and Ccuciferae: do they occur?, *Canadian Journal of Botony*, *56*,1978, 2813-2817.

[4.] B.E. Fajardo-Roldan, J.M. Barea, J.A. Ocampo, and C. Azcon-Angular, The effect of season on VA mycorrhiza of the almond tree and of phosphate fertilization and species of endophyte on its NNN mycorrhizal dependency, *Plant and Soil*. *68*, 1982, 361-367.

[5.] N.S. Bolan, A critical review on the role of mycorrhizal fungi in the uptake of phosphorus by plants, *Plant Soil*, *134*, 1991, 189-207.

[6.] C. Azcon-Aguilar, M. C. Jaizme-Vega, and C. Calvet, The contribution of arbuscular mycorrhizal fungi to control soil-borne plant pathogens: In Gianinazzi, S, Schuepp, H, Barea, J. M. Haselwandter, K, (eds.) *Mycorrhizal Technology in Agriculture*: From genes to bioproducts. Birkhauser Verlag AG, Basel, Switzerland, 2002, 187-197.

[7.] S. E. Smith, and D. J. Read, *Growth and carbon economy of VA mycorrhizal plants. In: Mycorrhizal Symbiosis*. 2nd ed. Academic Press, London, 1997, 105- 125.

[8.] J.W. Gerdmann, and T.H. Nicholson, Spores of mycorrhizal endogone extracted from soil by wet sieving and decanting, *Transactions of the British Mycological society*, *46*, 1963, 234 – 235.

[9.] Y. Bergeron, A. Leduc, B.Harvey, and S. Gauthier, Natural fire regime: a guide for sustainable management of the Canadian boreal forest, *Silva Fennica*, *36*, 2002, 81 – 95.

[10.] M C. Nisha, M S. Subramaniam, and S. Rajeshkumar, Diversity of arbuscular mycorrhizal fungi associated with plants having tubers from Anaimalai Hills, *Journal for Bloomers of Research*, vol.2, 2010.

[11.] M.U.F. Kirschbaum, The temperature dependence of soil organic matter decomposition and the effect of global warming on soil organic storage, *Soil Biology and Biochemistry*, *27*, 1995, 753-760.

[12.] D.V. Badri, N. Quintana, E.G. El Kassis, H.K. Kim, Y.H. Choi, et al, An ABC transporter mutation alters root exudation of phytochemicalsthat provoke an overhaul of natural soil microbiota, Plant Physiol., 151,2009, 2006-17.

[13.] R.A. Lankau, Intraspecific variation in allelochemistry determines an invasive species' impact on soil microbial communities, Oecologia, 16, 2011, 453-63.

[14.] J.D. Bever, Negative feedback within a mutualism: Host-specific growth of mycorrhizal fungi reduces plant benefit. Proc. Biol. Sci., 269, 2002, 2595-601.

[15.] G. Supriya, and K. Purshotam, Effect of seasonal variation on mycorrhizal fungi associated with medicinal plants in central himaliyan region of India, *American Journal of Plant Sciences*, *3*, 2012, 618-626