International Journal of Pharmaceutical Science Invention
ISSN (Online): 2319 – 6718, ISSN (Print): 2319 – 670X
www.ijpsi.org Volume 3 Issue 10 ǁ October 2014 ǁ PP.32-40

Impact of Some Ecological Factors on the Occurrence and Distribution of Mitosporic Fungi in the Cold Desert of Ladakh (India).

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ABSTRACT: *Extreme nature of climate and topographical conditions may affect the soil properties, which in turn affect the occurrence and distribution of mycoflora inhabiting cold desert high altitude. In view of this, investigations were carried out to assess the ecological factors regulating the distribution and survival of mitosporic fungi inhabiting the base soil of Moonland (Ladakh), a completely barren, distinctive, splendid, moon-like landscape situated in the Ladakh region of Jammu and Kashmir state (India). The soils were nearly neutral to slightly alkaline and with moderate electrical conductivity. Electrical conductivity showed a negative effect on the occurrence and distribution of mitosporic fungi as well as on majority of the macronutrients. All the soil samples showed good amount of organic matter and the mitosporic fungi were generally found to be proportional to the soil organic matter, organic carbon and pH. The soil samples also possessed high amounts of phosphorus but low levels of potassium. The micronutrients were present in sufficient amounts in all the investigated soil samples. Physico-chemical soil parameters and majority of the macronutrients played an important role in the occurrence, diversity, distribution, and relative abundance of fungal species in the investigated soil samples.*

KEY WORDS*: ecological factors, mitosporic fungi, cold desert, Ladakh.*

I. INTRODUCTION

Mitosporic fungi represent more than half of the Ascomycota and are very important as parasites and saprophytes. This group of fungi produces their spores asexually (conidia or oidia) or by budding. There are about 25,000 species that have been classified in the Deuteromycota and many of them are anamorphs Basidiomycota or Ascomycota anamorphs. Studies on the soil fungal population in different geographical regions have shown that the mitosporic fungi are the largest, most varied and best represented group. The numbers and kinds of micro-organisms present in the soil depend on many environmental factors, such as, amount and type of available nutrients, available moisture, degree of aeration, pH, temperature, etc. Microorganisms respond to nitrogen (Jenkins *et al.,* 1988), organic matter (Lynch and Whipps, 1990) and soil moisture (Wardle, 1992). Their abundance in soil varies spatially as well as temporally and this pattern is related to temporal and spatial variations in the quantity and quality of nutrients (Wardle, 1992). Among the various nutrients, organic carbon, nitrogen, phosphorous and potassium are very important for fungi. In the absence of any one of these, the growth and sporulation of fungi and other microorganisms gets hampered. Magnesium, manganese and iron though needed in very small quantities, are also essential (Saksena, 1955). The availability of other micro nutrients such as, Fe, Mn, Cu and Zn in 1–25 ppm concentration is also essential (Alexander, 1986). In addition, soil temperature, pH and moisture are some of the major factors affecting fungal population and diversity (Song *et al*., 2004). In view of this, soil samples from four different sites of Moonland landscape at Lamayuru (Ladakh) were analysed for their nutrients and physico-chemical properties in order to assess their influence on the occurrence and distribution of mitosporic fungi. The various characteristics of soil that were investigated included macronutrients viz., nitrogen (N), carbon (C), phosphorus (P), potassium (K) and sulphur (S); micronutrients viz., zinc (Zn), copper (Cu), manganese (Mn) and iron (Fe); and physico-chemical properties viz., pH, electrical conductivity and texture.

II. MATERIALS AND METHODS

Soil samples were collected from four base sites of Moonland, Ladakh about 3300 mts above the sea level with a latitude and longitude of 30^{o}N-36^{o}N and 76^{o}E-79^{o}E and were brought to the laboratory in pre-sterilised polythene bags. For the isolation of mitosporic fungi, dilution pour plate method was used. For the purpose of identification, the isolated fungal species were grown and made to sporulate on different culture media, such as potato dextrose agar medium (PDA), malt extract agar medium (MEA), Czapek yeast agar medium (CYA), potato sucrose agar medium (PSA) and water agar medium (WA).

The recovered fungal species were identified on the basis of their macro and micro-morphological characters using various keys and relevant literature.

Analysis of soil samples: The various characteristics of soil that were investigated included macronutrients viz., nitrogen (N), carbon (C), phosphorus (P), potassium (K) and sulphur (S); micronutrients viz., zinc (Zn), copper (Cu), manganese (Mn) and iron (Fe); and physico-chemical properties viz., pH, electrical conductivity and texture. Total nitrogen was determined by Kjeldahl's method (Subbiah and Asija, 1956). in which a known weight of soil is treated with an excess of alkaline potassium permanganate, which extracts relatively easily oxidizable fractions of organic matter. Ammonia evolved is absorbed in a known volume of standard acid, the excess of which is titrated against standard alkali using methyl red as an indicator.Organic carbon was determined by rapid titration method in which oxidisable organic matter of soils is oxidised by potassium dichromate in the presence of concentrated sulphuric acid. The excess of potassium dichromate is determined by titration with ferrous sulphate or ferrous ammonium sulphate solution in the presence of diphenylamine indicator and sodium fluoride powder. The quantity of substance oxidised is then calculated from the amount of potassium dichromate reduced or used for oxidation.

Humus (organic matter) was calculated by multiplying the Walkley Black value (i.e. percent of carbon in the soil) by a factor of 1.724 (percent of organic matter in soil = percent carbon in soil). Phosphorus was determined by colorimetric method (Olsen *et al.*, 1954) which is based on the extraction of available phosphorus from the soil as phosphates by shaking with sodium bicarbonate solution adjusted to pH 8.5 which raises the activity of carbonate ions and decreases the calcium activity and thus results in release of some phosphates from the surface of calcium phosphates. The soluble phosphates form heteropoly complexes with molybdate ions which gives a yellow colour and simultaneously reduction with stannous chloride indicator gives a blue colour. The intensity of the colour is propotional to the concentration of P in the sample which can be read on a colorimeter/spectrophotometer at 660 µ wave length using red filter.Potassium was determined by ammonium acetate method which is based on the principle that when large number of elements when excited in a flame emit radiations at characteristic wavelengths. The excitation causes one of the electron of neutral atoms to jump to an outer orbit of higher energy level or the atoms may be excited sufficiently to loose an electron completely. When the excited atom return to lower energy level, light of characteristic wavelength is emitted. Excited atoms or ions give line radiations at a very definite wave length and potassium gives at 404 and 707 µ emission. Available sulphur was determined by turbidimetric method (Chesnin and Yien, 1951) which is based on the reduction in the intensity of light passing through a solution containing suspended particles of barium sulphate.

Sulphate ions are precipitated in aqueous solution by adding finely divided barium chloride crystals, being fine, the barium sulphate precipitate remains suspended in the solution and its effect on light transmission through the solution is measured by means of a colorimeter or spectrophotometer at 440 µ. Micronutrients were determined using DTPA (Diethyltriamine penta acitic acid) method (Lindsay and Norvell, 1978) which involves shaking the soil sample with a buffered solution chelating agent that can extract easily soluble Zn, Cu, Fe and Mn cations which can be determined on AAS. The basis of analytical absorption spectrophotometry is the measurement of the absorption of light energy by free atoms in ground state and its quantitative correlation with the concentration of the analytic solution. The absorption of light by the vapourised sample is related to the concentration of the desired metal in it. Texture was determined by hydrometer method, percentage of sand, silt and clay was calculated using the diagram for textural triangle to determine the textural class of the soil (Figure 1).

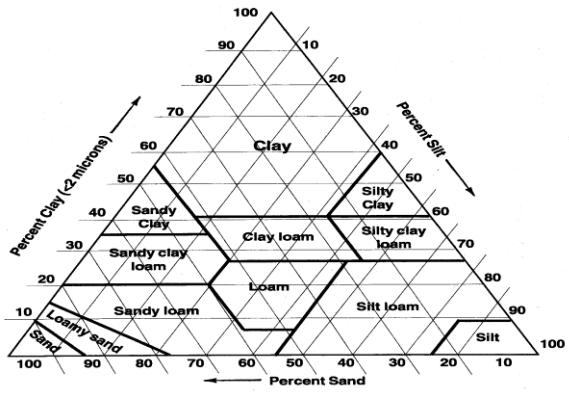

Figure 1. Soil textural classes according to proportions of sand, silt and clay.

pH and electrical conductivity of the soil samples were determined using pH meter and conductivity meter respectively.

III. RESULTS AND DISCUSSIONS

A total of 32 fungal species belonging to 14 genera were recovered by using dilution plate technique and it was observed that all the four base sites of Moonland landscape at Lamayuru that were examined were positive for them and maximum number of fungal species (25) were recovered from site 4, followed in decreasing order by site 3 (21 species), site 2 (19 species) and site 1 (17 species). The recovered mitosporic fungi are tabulated below.

S. No.	Fungal species	Recovery from different sites			
		Site 1	Site 2	Site 3	Site 4
1.	*Alternaria alternate*	-	+	+	+
2.	*Alternaria citri*	-	-	-	+
3.	*Alternaria longipes*	-	-	+	+
4.	*Aspergillus flavus*	+	+	+	+
5.	*Aspergillus fumigatus*	+	+	+	+
6.	*Aspergillus niger*	+	+	+	+
7.	*Aspergillus ochraceous*	+	+	+	+
8	*Aspergillus parasiticus*	+	+	-	-
9.	*Aspergillus penicillioides*	+	-	-	-
10.	*Aspergillus sydowii*	+	+	+	+
11.	*Aspergillus versicolor*	-	+	+	+
12.	*Cladosporium cladosporioides*	+	+	+	+
13.	*Cladosporiuym oxysporum*	+	+	+	-
14.	*Cladosporium sphaerospermum*	-	+	+	+
15.	*Curvularia brachyspora*	-	-	+	+
16.	*Curvularia pallescens*	-	-	+	+
17.	*Dendryphiella vinosa*	-	-	-	+
18.	*Drechslera australiensis*	+	+	+	+
19.	*Fusarium pallidoroseum*	-	-	-	+
20.	*Fusarium verticilloides*	-	-	-	+
21.	*Humicola fuscoatra*	-	-	-	+
22.	*Paecilomyces lilacinus*	+	+	-	-
23.	*Penicillium griseofulvum*	+	+	+	+
24.	*Penicillium italicum*	+	+	+	+
25.	*Penicillium olivicolor*	+	+	+	-
26.	*Penicillium puberulum*	-	-	+	+
27.	*Penicillium purpurogenum*	-	-	-	+
28.	*Penicillium verrucosum*	+	+	+	+
29.	*Rhinocladiella cellaris*	-	-	-	+
30.	*Sporothrix schenckii*	-	-	+	-
31.	*Trichoderma viride*	+	+	-	-
32.	*Ulocladium atrum*	+	+	+	+

+ , present - , absent

Soil texture and fungal population : Data tabulated in table 1 shows that in all the four soil samples, sand contributed maximum portion (62% in sampling site 1 and 2, 40% in sampling site 3 and 35% in sampling site 4), followed in decreasing order by silt (24%, 33%, 38% and 40% for sampling sites 1, 2, 3 and 4 respectively), whereas minimum percentage was that of clay (13%, 18%, 21% and 25% for sampling sites 1, 2, 3 and 4 respectively). Similar results were also obtained by Charan *et al.* (2013) for the cold desert soil of Ladakh at different altitudes wherein they found dominance of sand fraction, which increased along the altitude. According to Dwivedi *et al*. (2005), soils of cold desert high altitude areas have originated from weathered rocks and they are immature having large proportion of sand, gravel and stone.

During the investigation, texture of the soil samples was determined according to the proportions of sand, silt and clay by using the soil textural triangle (Figure 1). It was observed that the soil samples of site 1 and 2 were having loamy texture while that of site 3 and 4 were having silty loam texture (Table 1). Data provided in table 1 also indicates that silty loam soil favours the prevalence of mitosporic fungi more prolifically in comparison to loamy soils as the number of recovered mitosporic fungi was more in soil samples of site 3 and 4 than that of site 1 and 2. Although, many of the recovered fungi were common to the sampling sites, yet three fungal species viz., *Aspergillus penicillioides*, *Trichoderma viride* and *Paecilomyces lilacinus* were recovered exclusively from loamy soil samples and 12 fungal species viz., *Sporothrix schenckii*, *Alternaria citri*, *A. longipes*, *Dendryphiella vinosa*, *Fusarium pallidoroseum*, *F. verticilloides*, *Humicola fuscoatra*, *Curvularia brachyspora*, *C. pallescens*, *Penicillium puberulum*, *P. purpurogenum* and *Rhinocladiella cellaris* from silty loam soils. Filamentous fungi grow in soil via an expansive growth habit and physical impedance due to changes in soil structure can affect the ability of fungi to penetrate soil. Earlier, many workers have observed that the growth of fungi is affected by soil porosity and their penetrance in sand is reduced with pore size (Otten and Gilligan, 1998; Harris *et al*., 2003; Drew *et al*., 2003). Reduction in soil pore size may also directly advantage fungal species with smaller hyphal width, such as the mitosporic fungi. Later, Wakelin *et al*. (2008) derived a link between soil textural properties and fungal community structure.

pH and fungal population : Data on the pH of soil samples revealed that it varied from 7.45-8.12 (Table 1). This shows that the soil of Moonland is neutral to slightly alkaline and it favoured the prevalence of some specific mitosporic fungi, which were detected from the samples. The recovered fungal species can be categorized as alkalophillic fungi as three of the four soil samples were slightly alkaline. In the present investigation, it was observed that with a slight increase in pH value of the soil samples, there was a corresponding increase in the number of fungal species. Soil pH is considered as one of the major factors affecting fungal population and diversity (Song *et al*., 2004; Wakelin *et al*., 2008 and Rousk *et al*., 2009). In addition, pH strongly influences abiotic factors, such as, carbon availability, nutrient availibility (Kemmitt *et al*., 2006), solubility of metals (Flis *et al*., 1993) and may control biotic factors, such as, the biomass composition of fungi (Fierer and Jackson, 2006). Earlier, Abdel-Sater (1987) also found that the pH values of cultivated, desert and saline soils gathered from Egypt fluctuated between 7.2-8.9, 6.9-7.4 and 7.2-8.8 respectively. Later, similar observations were obtained by Abdel-Hafez *et al.* (1991) and by El-Said (1994). However, in contrast to our observations, Rousk *et al*. (2009) observed that an acidic pH (4.5) favoured a marked fungal growth.

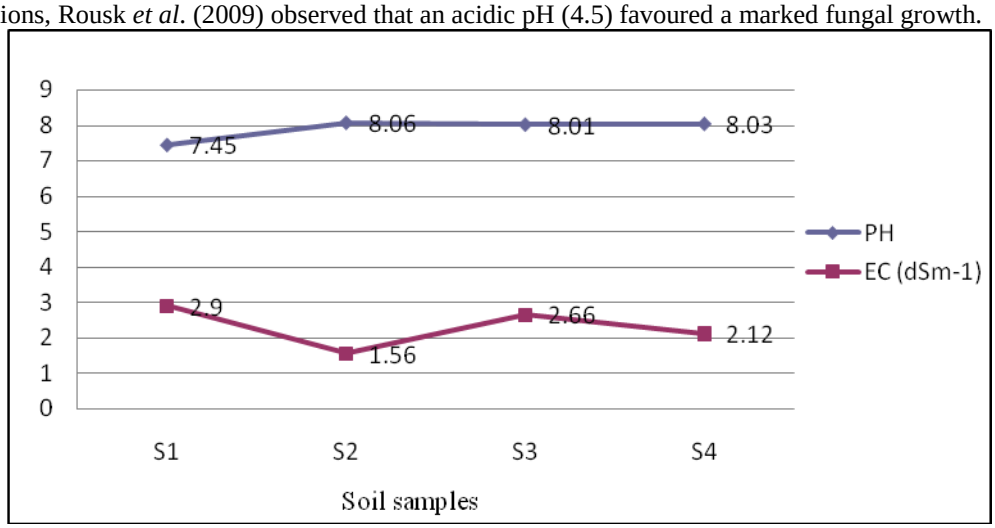

Figure 2. pH and electroconductivity (EC) of the soil samples from four sites of Moonland (Lamayuru), Ladakh.

Electical conductivity and fungal population : Electrical conductivity (EC) indicates the presence or absence of salts, but does not indicate which salt may be present. According to FAO, soil salinity is assessed by the measurement of electrical conductivity of soil extracts (Landon, 1991). Soil salinity is part of natural ecosystems under arid and semi-arid conditions (Pathak and Rao, 1998). During the present investigation, electrical conductivity (dSm^{-1}) for the soil samples ranged from 1.56-2.90 showing that the soil samples were slight to moderate in their conductivity. The reason for such level of conductivity may be attributed to the extremely low precipitation due to which soluble salts are more likely to accumulate in soil profiles resulting in high EC. It was also observed that with an increase in soil conductivity, there was a corresponding decrease in pH (Figure 1).

The highest electrical conductivity was observed for soil samples from site 1 in which only 17 fungal species were recovered, whereas lowest EC was that for site 2 from where 19 fungal species were recovered. This indicates that high electrical conductivity (2.9) does not support fungal growth as prolifically as the soils with low or moderate conductivity (1.53 – 2.66). In addition, it was also observed that the organic carbon and nitrogen content of soils from site 1 was least, indicating thereby that the soil nutrients are sensitive to high electrical conductivity. These results are in accordance with the earlier findings of Tripathi *et al*. (2006) and Shah and Shah (2011) who observed a decrease in the microbial biomass carbon, nitrogen, nitrogen mineralization, nitrification, rate of CO_2 evolution and cumulative CO_2 production with an increase in electrical conductivity.

Organic carbon and fungal population : As shown in table 1, the four soil samples of Moonland (Lamayuru) possessed good amount of organic carbon as it was present in moderate to high concentrations and the occurrence of mitosporic fungi was found directly proportional to the soil organic carbon. It was observed that the number of mitosporic fungal species (17, 19, 21 and 25) increased proportionately with the increase in organic carbon at site 1, 2 3 and 4 respectively indicating thereby, the role of organic carbon in the prevalence of soil fungal species. Similar results were observed in case of organic matter as it was found to influence the distribution of the mitosporic fungi in the soil samples of the four sites (Table 1). Charan *et al*. (2013) also detected good amount of organic matter and organic carbon in high altitude cold desert soils of Ladakh. Higher precipitation in the form of snow at high altitude and subzero temperature causes hyper aridity of soil and suppression of microbial enzymatic activities, which results in least soil organic matter decomposition that contributes to higher accumulation of soil organic carbon (Schinner, 1982; Jacot *et al*., 2000; Bhattacharyya *et al*., 2008). This might be the probable reason that why cold arid bioclimate of Ladakh contains more soil organic carbon (SOC) and soil organic matter (SOM).

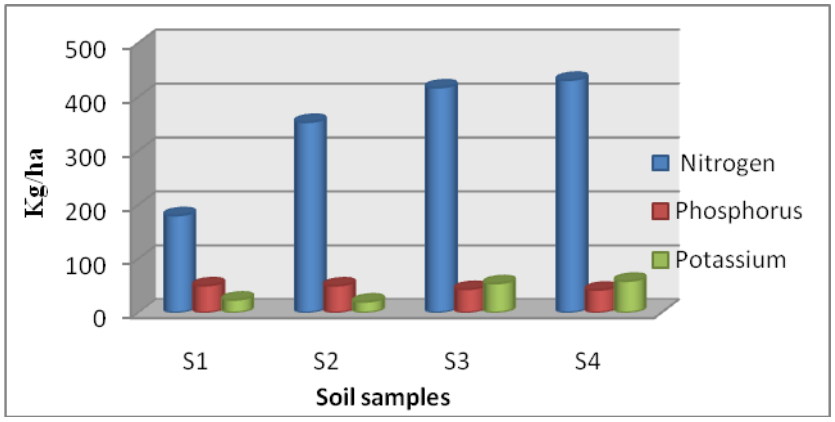

Figure 3. Nitrogen (N), phosphorus (P) and potassium (K) content of the soil samples from four sites of Moonland (Lamayuru), Ladakh.

Nitrogen and fungal population : The soil sample from site 1 possessed very low level of nitrogen (180 kg/ha) in comparison to other three soil samples, which showed medium level ranging from 353-431 kg/ha (Figure 3). During the present investigation, *Aspergillus penicillioides* was recovered only from site 1, which indicates that it can grow in soils containing low nitrogen and other nutrients. Recently, Ali *et al*. (2013) also reported *A. penicillioides* from soil samples of man-made solar saltern in Thailand, which contained relatively low nitrogen, organic carbon and organic matter. Other species of recovered fungal genera did not show any particular trend with respect to their incidence and the content of organic carbon, organic matter, nitrogen and potassium present in the soils.

Potassium and fungal population : As per the data on soil ratings, the content of potassium in all the soil samples was low (< 110 kg/ha) with soil samples from site 1 and 2 showing comparatively lower content than site 3 and 4. These results are in contrast to the findings of earlier workers who observed medium to high amounts of potassium in other soils (Arokiyaraj, 2011; Singh and Mishra, 2012; Pandey *et al*., 2013; Singh and Rathore, 2013). During the present investigation, some of the fungal species were detected exclusively in soil samples of site 3 (*Sporothrix schenckii*) and site 4 (*Alternaria citri, Dendryphiella vinosa, Fusarium pallidoroseum, F. verticilloides, Humicola fuscoatra, Penicillium purpurogenum* and *Rhinocladiella cellaris*), which indicates that these fungi show preference for elevated amounts of potassium as well as majority of the other macro and micronutrients. Similar conclusion can be assigned to the fungal species viz., *Alternaria*

longipes, *Curvularia brachyspora*, *C. pallescens* and *Penicillium puberulum*, which occurred in soil samples of both site 3 and 4. On the other hand, fungal species, such as, *Aspergillus penicillioides*, *Paecilomyces lilacinus* and *Trichoderma viride*, which were detected only from soil samples of site 1 and 2, show that they have the ability to survive in habitats with relatively low levels of potassium, nitrogen, organic carbon and organic matter.

Phosphorus and fungal population : Perusal of data on available phosphorus presented in table 1 shows that its content ranged between 41-50 kg/ha. Considering the available phosphorus rating values i.e., low (< 10 kg/ha), medium (10-24 kg/ha) and high (>24 kg/ha), it was observed that all the soil samples obtained from Moonland, Lamayuru in Ladakh were high in available phosphorus. Majority of the other macronutrients viz., nitrogen, potassium and carbon were found to be maximum in site 4, followed in decreasing order in site 3, 2 and 1, whereas the content of phosphorus was found to be reverse (Table 1). Earlier, Singh and Rathore (2013) made a comparative study of the soil properties of Aravalli mountain ranges and Malwa Plateau in Rajasthan and also detected maximum content of available phosphorous in the soils of hill top followed in decreasing order by valley, whereas lowest phosphorus value was detected in the soil of plain areas. Moreover, they also observed a negative correlation with clay and silt and pointed out that there was a negative impact of topography on available phosphorus. Phosphorus, nitrogen, potassium and organic carbon are very important nutrients for the growth and sporulation of fungi and other microorganisms which otherwise gets hampered (Saravanakumar and Kaviyarasan, 2010).

Sulphur and fungal population : As shown in table 1, available sulphur was present in sufficient amounts (> 20 ppm) in all the soil samples taken from Moonland and their content was nearly equal. In view of this, correlation between sulphur and other parameters of soil could not be established. In addition, the levels of sulphur and phosphorus in all the four soil samples did not show much variability and thus their impact on the diversity of mitosporic fungi could not be established.

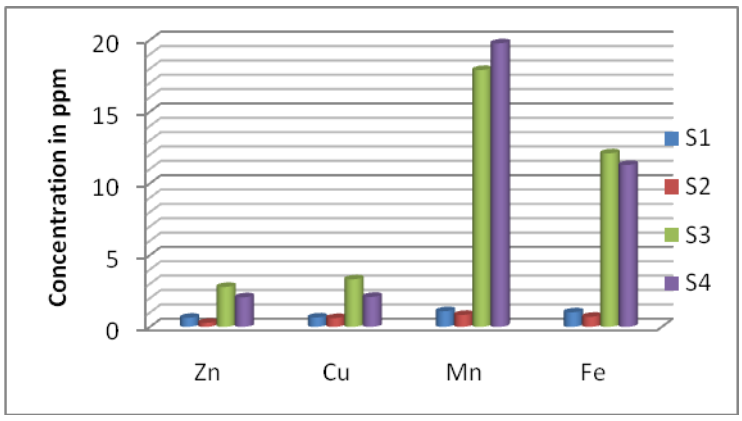

Figure 4. Zinc (Zn), copper (Cu), manganese (Mn) and iron (Fe) content of the four sites of Moonland (Lamayuru), Ladakh.

Micronutrients and fungal population : As per the data on soil ratings, the micronutrients were present in sufficiently adequate amounts with zinc ranging from low to high (low in site 2 and high in site 1,3 and 4), copper high in all the sites (maximum in site 3, followed in decreasing order by that of site 4, 1 and 2), manganese ranging from medium to high (medium in site 1 and high in site 2, 3 and 4) and iron ranging from low to high (low in site 1, medium in site 2 and high in site 3 and 4). The micronutrients such as copper, zinc and iron were highest in the soil samples of site 3 followed by that of site 4. However, manganese content was slightly higher in soil sample of site 4 (Figure 4). In India, analysis of 2.52 lakh surface soil samples collected from different parts of the country revealed the predominance of zinc deficiency in divergent soils (Govindaraj *et al*., 2011). However, in contrast, the results obtained in the present investigation revealed that the soil samples of Moonland landscape at Lamayuru, (Ladakh) possessed sufficient amounts of zinc. Further, as shown in table 1, it was observed that with an increase in pH, there was a corresponding decrease in zinc content indicating its sensitivity to high pH. A negative correlation between pH and zinc content of Aravalli mountain ranges was also observed by Singh and Rathore (2013). During the present investigation, available copper in all the soil samples was also found to be in sufficient amounts. However, a negative correlation between pH and available copper was noticed. Similar correlation was also observed by Mahashabde *et al.* (2012), Singh and Rathore (2013) and Pandey *et al*. (2013).

As per the soil ratings, majority of the investigated soil samples showed high amounts of manganese (1.09-19.76) and iron (1.01-12.09). These results corroborate with the earlier findings of Sharma *et al*. (2006). Similar predictions were also given by Gilkes and Mc Kenzie (1988) who observed that manganese is more abundant in soils developed from rocks rich in iron, thereby showing association of these two elements.The availability of micronutrients increased significantly with increase in finer fractions (silt and clay) because these fractions are helpful to improve soil structure and aeration, which are favourable conditions for increasing availability. Similarly, the availability of micronutrients also enhanced significantly with an increase in the organic matter of the soil. It happens because organic matter is helpful in improving soil structure and aeration; it protects the oxidation and precipitation of micronutrients into unavailable forms and supplies soluble chelating agents, which increase the solubility of micronutrients. Similar findings were reported by Sharma *et al*. (2003) who observed that the micronutrients Zn, Cu, Fe and Mn showed positive correlation with silt, clay, organic matter and organic carbon. In the present investigation, mitosporic fungi were found to show preference for the soils with elevated amounts of micronutrients as their number as well as diversity enhanced with increased level of micronutrients.

Table 1. Soil characteristics and mitosporic fungi of the four soil samples of Moonland (Lamayuru), Ladakh.

Soil characters	**Soil samples**			
	S1	**S2**	**S3**	**S4**
pH	7.45	8.06	8.01	8.03
EC(dSm^{-1})	2.90	1.56	2.66	2.12
OC (%)	0.66	0.72	0.80	0.97
N (Kg ha^{-1})	180	353	417	431
P (Kg ha^{-1})	50	50	43	41
K (Kg ha^{-1})	23	20	54	58
S (ppm)	22	22	23	22
Zn (ppm)	0.63	0.28	2.78	2.06
Cu (ppm)	0.65	0.61	3.3	2.09
Mn (ppm)	1.09	3.30	17.96	19.76
Fe (ppm)	1.01	2.09	12.09	11.28
Silt (%)	24	33	38	40
Clay (%)	13	18	21	25
Sand (%)	62	62	40	35
Organic matter (%)	1.13	1.24	1.37	1.67
Mitosporic fungi recovered	*Aspergillus flavus* *A.fumigatus* *A. niger* *A.ochraceous* *A. parasiticus* *A. penicillioides* *A. sydowii* *Cladosporium oxysporum* *C.cladosporioides* *Drechslera australiensis* *Paecilomyces lilacinus* *Penicillium griseofulvum* *P.italicum*	*Alternaria alternata* *Aspergillus flavus* *A. fumigatus* *A. niger* *A.ochraceous* *A. parasiticus* *A. sydowii* *A. versicolor* *Cladosporium oxysporum* *C. sphaerospermum* *C.cladosporioides* *Drechslera australiensis* *Paecilomyces*	*Alternaria alternata* *A.longipes* *A. fumigatus* *A. flavus* *A. niger* *A.ochraceous* *A. sydowii* *A. versicolor* *Cladosporium oxysporum* *C.cladosporioides* *C. sphaerospermum* *Curvularia brachyspora* *C. pallescens*	*Alternaria alternata* *A.longipes* *A. citri* *Aspergillus flavus* *A. fumigatus* *A. niger* *A.ochraceous* *A. sydowii* *A. versicolor* *Cladosporium cladosporioides* *C. sphaerospermum* *Curvularia brachyspora* *C. pallescens* *Dendryphiella vinosa* *Drechslera*

	P.olivicolor *P.verrucosum* *Trichoderma viride* *Ulocladium atrum*	*lilacinus* *Penicillium griseofulvum* *P.italicum* *P.olivicolor* *P.verrucosum* *Trichoderma viride* *Ulocladium atrum*	*Drechslera australiensis* *Penicillium griseofulvum* *P.italicum* *P.olivicolor* *P. puberulum* *P.verrucosum* *Sporothrix schenckii* *Ulocladium atrum*	*australiensis* *Fusarium pallidoroseum* *F. verticilloides* *Humicola fuscoatra* *Penicillium griseofulvum* *P.italicum* *P. puberulum* *P. purpurogenum* *P.verrucosum* *Rhinocladiella cellaris* *Ulocladium atrum*
Total species recovered	**17**	**19**	**21**	**25**

III. CONCLUSION

Therefore, from the present investigation, it is concluded that some of the soil factors, such as, slight alkalinity, high electrical conductivity (salinity), low amount of some nutrients and harsh climatic conditions, such as, extremely low temperature, high UV radiations and arid conditions do not suppress the prevalence of mitosporic fungi in such habitats. However, their diversity is affected by the fluctuations in the soil properties as observed during the present investigation. Good amount of organic matter, carbon, phosphorus and micronutrients favour mitosporic fungi by playing a vital role in their structural and metabolic processes. It is complicated to determine the order of importance of these factors as they are often closely related and show a collective effect.

IV. ACKNOWLEDGEMENTS

The first author is grateful to University Grants Commission (UGC), New Delhi for the financial assistance in the form of Rajiv Gandhi National Fellowship (RGNF), which facilitated the study.

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