International Journal of Advanced Research in Biological Sciences
ISSN: 2348-8069
www.ijarbs.com
DOI: 10.22192/ijarbs Coden: IJARQG(USA) Volume 3, Issue 12 - 2016

Research Article

DOI: http://dx.doi.org/10.22192/ijarbs.2016.03.12.012

Influence of physico chemical parameters on the fungal diversity in Yercaud hills in Salem district, Tamil Nadu, India

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Abstract

In Biodiversity study, the monthly soil sample was collected from three different biotopes of Yerkaud *viz* for a period of one year from June 2010 to May 2011, various physico-chemical and microbiological parameters were estimated using standard procedures. The fungal strains from soil sample was isolated on potato dextrose agar and identified based on standard mycological references. The data were presented in terms of 'Periodicity of occurrence' and 'Percentage frequency' and the same terminology has been used.

Keywords: Biodiversity, Fungi, physico-chemical and microbiological parameters, Percentage frequency
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Introduction

Fungi are heterotrophs and subsist mainly on live or dead, plant or animal-derived organic matter. They are ubiquitous in nature and are the second largest group of living organisms after insects (Hawksworth, 1991). Number of species of fungi around the world has been estimated to be 1.5 million about 80,000 of which have so far been described and documented Hawksworth *et al*., 1995(Kirk *et al*., 2001).

Fungi live on plants as saprophytes, parasites and mutualists. The association of fungi with plants is so intense that they form an amalgamation with one another. Richness in fungal diversity is attributed to the highly diverse plant species and varied vegetation types in the world's ecosystems especially in the tropics which embody a flourishing diversity of fungi (Hyde, 1997). An exceedingly large number of novel fungi discovered from the tropical belt in the recent years are a testimony of richness of fungal kingdom (Hyde, 1992; Bhat and Kendrick, 1993; Castafieda and Kendrick, 1991; Subramanian and Bhat, 1987).

Presently, the "fungi" as a mega-diverse group span three kingdoms, most belonging to the Fungi (Eumycota), while others are classified in the Protozoa and Chromista (Straminipila) (Cavalier-Smith 1998, James *et al.*, 2006b). Among all organisms, fungi are the second largest group in the world after insects (Hawksworth, 1991, 2001). They are cosmopolitan in distribution, found in air, water, soil, on dead organic matters, living things, etc. They are the major components of tropical ecosystems throughout the world, involved in innumerable interaction with plants, animals and man, ranging from saprophytism to parasitism and symbiosis.

The number of fungi recorded in India exceeds 27,000 species, the largest biotic community after insects.

The true fungi belong to kingdom Eukaryota which has four phyla, 103 orders, 484 families and 4979 genera. The eighth edition of Dictionary of the Fungi has recognized eleven phyla.

Tamil Nadu has a vast area of forests which are rich in bio-diversity. Forests are classified in to different ways depending on climate, soil type, topography, and elevation. Studies of soil fungi have been engaging the attention of a large number of workers, the ecological factors, which govern their distribution, have not been seriously studied still recently, particularly in India. The state of Tamil Nadu is still unexplored.

From the late 1940s, there has been a growing interest in mycology and fungal diseases of plants and it has motivated the studies on fungi and their ecology (Subramanian, 1982, 1986). Though, numerous species of fungi have been reported from the Western Ghats (Rangaswamy *et al.*, 1970; Bilgrami *et al.*, 1991), there appears to have been no study related to the diversity or dynamics of fungal population in forest (Subramanian, 1986). General ideas about species diversity suggest that habitat heterogeneity is a major factor controlling diversity (Gentry, 1988).

The distribution of these organisms is influenced by the abundance and nature of the organic content of the soil, as well as by other soil and climatic conditions, surface vegetation and soil texture (Waksman, 1944; Marschner *et al*., 2003). While the general nature of the soil micro flora has become recognized, details, particularly the ecological variation of its members, are not always clear.

Fungi are an important component of the soil micro biota typically constituting more of the soil biomass than bacteria, depending on soil depth and nutrient conditions (Ainsworth and Bisby, 1995). The saprophytic fungi represent the largest proportion of fungal species in soil and they perform a crucial role in the decomposition of plant structural polymers, such as, cellulose, hemicelluloses and lignin, thus contributing to the maintenance of global carbon cycle.

Biodiversity of fungi – this study was designed with the following objectives

- To isolate and identify the fungi from shevaroy Hills
- To identify the influence of physico chemical parameters on the fungal diversity and species composition

Materials and Methods

Study area:

Yercaud is one of the cutest hills stations in the Servarayan range of hills (11˚77◌ N & 78˚20◌ E) of Eastern Ghats in Salem district of Tamil Nadu at an altitude of 1515 m above mean sea level. The average rainfall of the area is 1500 - 2000 mm. The maximum temperature ranges between 25˚C and 30˚C and minimum between 13˚C and 16˚C. The soil is deep and non-calcareous. The topmost hill area is characterized by clay loamy soil whereas the bottom of the valley is distinguished by alluvial and clay loam soil. The forest types range from evergreen to moist deciduous (Champion & Seth, 1968).

On the Western side of the hills, contrast Sholas still exist, though a great portion of the plateau is cleared (Udayan *et al*., 2006). The total extend of Yercaud taluk (sub-district) is 382.67 km^2 including reserve forest and the hill tribes are unique in that they have been isolated geographically and culturally from the caste in the groups in the plains for a long time. In the present study, three stations were selected in Yercaud Hills as given below.

- **Shevaroy Hills (station 1):** (Lat $11^0$81’ N; Long $78^0$21’E): It is situated on top of the flat-topped Shevaroy hills and about 6 km from Yercaud town.
- **Pyramid point (station 2):** (Lat $11^0$78’ N; Long $78^0$21’E): It is situated in the eastern part of Yercaud hills and about 4 km from Yercaud town.
- **Botanical Orchidarium (station 3):** (Lat $11^0$77’ N; Long $78^0$20’E): **It is situated** very close to Lady's Seat and about 2 km from Yercaud town.

Collection of sample

The present study was conducted for a period of one year from June 2010 to May, 2011, during which monthly collections were made for the estimation of various physicochemical parameters along with mycoflora. Rainfall data for Yercaud Hills region was obtained from Meteorological Department, Salem, Tamil Nadu, India. Based on the rainfall, four seasons are recognized in a calendar year. They are, Monsoon (October to December), Post-monsoon (January to March), summer (April to June) and pre-monsoon (July to September).

Soil sample

Soil sample were collected from three different stations Station-1(Shevaroy Hills), Station-2(pyramid point), Station-3(**Botanical Orchidarium**) of Yercaud hills belonging to Eastern Ghats of southern India from a depth of 6-10 cm. Samples were placed in plastic bags that were labeled appropriately and were transferred to the laboratory in an ice box maintained at 4^{o}C for further study.

Soil analysis

The following Physico-chemical parameters of the soil samples were analyzed in Soil testing laboratory, Dept of Agriculture, Government of Tamil Nadu, Tiruchirapalli-20.

Isolation of fungi

The fungal strains from soil samples were isolated using pour plate technique, as described below.

Serial dilution plate technique

Serial dilution plate technique was used for the isolation of fungi from soil sample as described by Warcup (1950). 10 g of soil from each sample was weighed separately and then dissolved in 100 ml distilled water. The flasks were shaken thoroughly in order to get uniform distribution of the soil. The soil suspension were diluted in 10 fold increment from 10^{-2} to 10^{-4}. One ml of the diluted sample was poured into sterile petri dishes and then potato dextrose agar medium (PDA and SDA) was poured into the plates. Before pouring the medium into petri dishes it was added with 1% streptomycin.

The plates were incubated at room temperature (27+2^{0}C) for 7 days. Three replicates were maintained for each sample. After three to four days of incubation, the colonies growing on PDA and SDA plates, with different morphology were counted and purified on PDA and SDA medium. A portion of the growing edge of each colony was picked up with the help of a pair of sterile needles and mounted on a clean glass slide with lacto phenol cotton blue. The slide was observed under microscope.

PDA composition:

Composition of PDA	Littre(gram/lit)
Potato infusion	200g
Dextrose	20g
Agar	15g
Distilled water	1000ml
pH	5.5

Sabouraud's dextrose agar composition:

Composition of SDA	Littre(gram/lit)
Dextrose	20g
Peptone mycological	10g
Agar	20g
Distilled water	1000ml
pH	5.6

Note: To eliminate the bacterial contamination 8 ml of 1% Streptomycin was added to 1 liter of the sterilized medium.

The number of fungal colonies in water and sediment samples was counted and the density was calculated as per the formula given below and expressed as Colony Forming Units (CFU).

$$\text{Fungal density} = \frac{\text{Degree of dilution x Number of colonies}}{\text{Weight of soil/water}} = \text{CFU/g (or) CFU/ml}$$

Identification of fungi

The fungi were identified up to species level by referring standard mycological manuals such as Manual of Soil Fungi (Gilman, 1959 and 1998), Dematiaceous Hyphomycetes and More Dematiaceous Hyphomycetes (Ellis, 1971 and 1976), Hyphomycetes (Subramanian, 1971), Micro fungi on Land Plants (Ellis and Ellis, 1985).

Results

Table 1. Periodicity of occurrence of mycoflora in various stations in Yercaud Hills

S. No	Name of the Fungal species	Yercaud Hills		
		Station 1	Station 2	Station 3
Zygomycota				
1)	*Absidia corymbifera*	-	√	√
2)	*Cunninghamella echinulata*	√	-	√
3)	*C. elegans*	√	-	-
4)	*Mucor racemosus*	-	√	√
5)	*Rhizopus nodosus*	√	√	-
6)	*Syncephalestrum racemosum*	-	-	√
Ascomycota				
7)	*Chaetomium globosum*	√	-	-
Mitosporic fungi				
Hypomycetes				
8)	*Acremonium murorum*	√	√	-
9)	*Alternaria citri*	-	√	√
10)	*A. tenuissima*	√	-	-
11)	*Aspergillus flavipes*	-	√	-
12)	*A. glaucus*	-	√	-
13)	*A. globosus*	-	-	√
14)	*A. nidulans*	√	-	√
15)	*A. niveus*	-	√	√
16)	*A. wentii*	√	-	-
17)	*Cephalosporium* sp.	-	√	√
18)	*Cladosporium indicum*	√	-	√
19)	*Curvularia eragrostidis*	√	√	-
20)	*C. lunata*	-	√	√
21)	*C. pallescens*	√	-	√
22)	*C. tuberculata*	-	√	√
23)	*Drechslera* sp	√	√	-
24)	*Fusarium oxysporum*	-	√	√
25)	*Humicola alopallenella*	√	-	-
26)	*Penicillium griseofulvum*	-	√	√
27)	*Pencillium* sp.	√	√	-
28)	*Pithomyces graminicola*	√	-	√
29)	*Scolecobasidium cylindrospora*	√	√	-
30)	*S. humicola*	-	√	-
31)	*Scopulariopsis breviacaulis*	-	-	√
32)	*Stachybotrys chartarum*	-	√	√
33)	*Trichoderma harzianum*	√	-	√
34)	*T. koningii*	-	√	√
35)	*T. viride*	-	√	√
36)	*Verticillium* sp	√	-	-
Coelomycetes				
37)	*Pestalopsis guepinii*	√	√	-
38)	*P. theae*	-	√	√
39)	*Phoma capitulum*	√	-	√
40)	*Chaetomium indicum*	√	-	-

Figure 1. Collections of samples

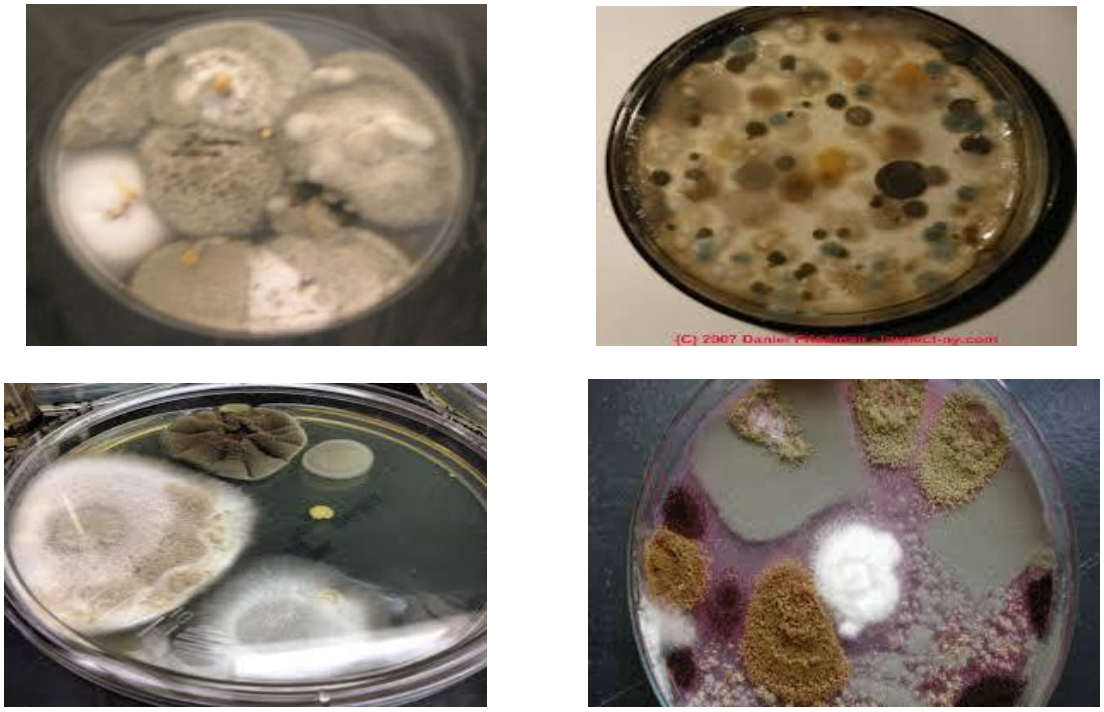
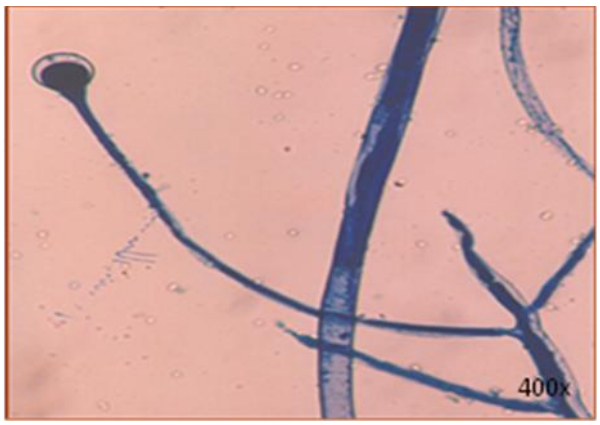
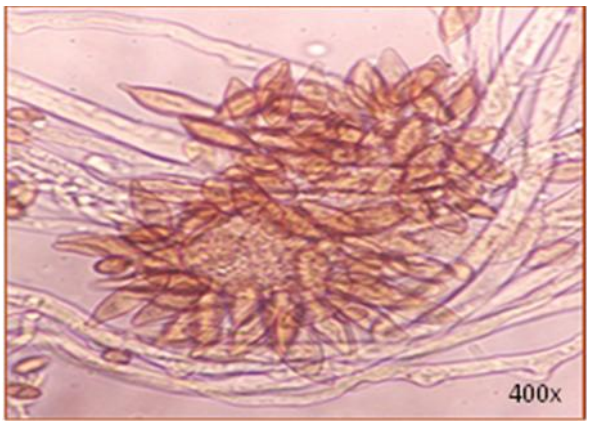


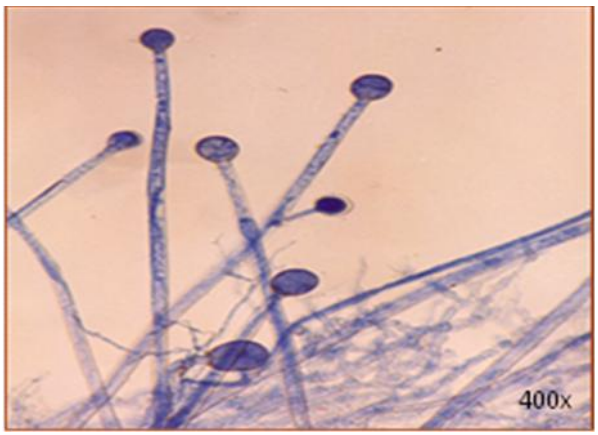
Figure 1. Isolation of fungi from soil sample



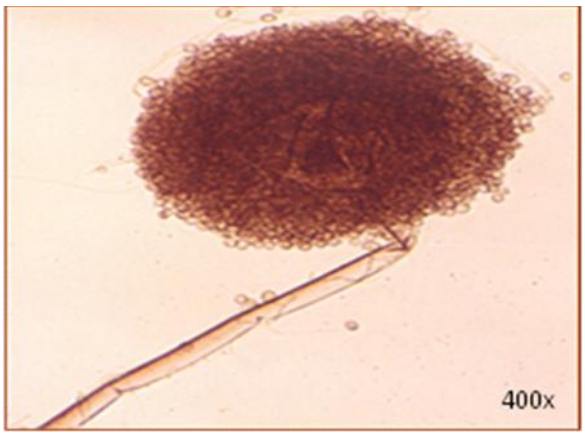
Absidia corymbifera



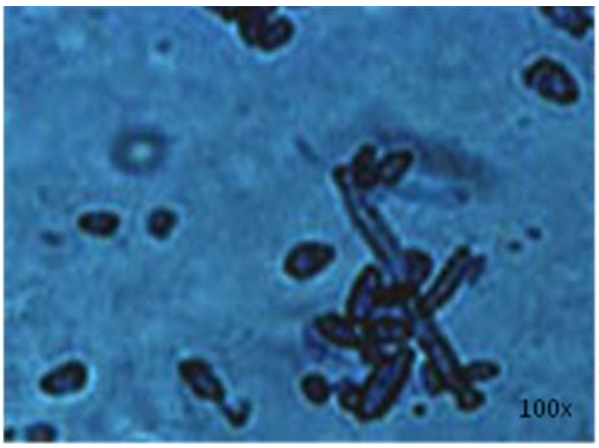
Choanephora sp.



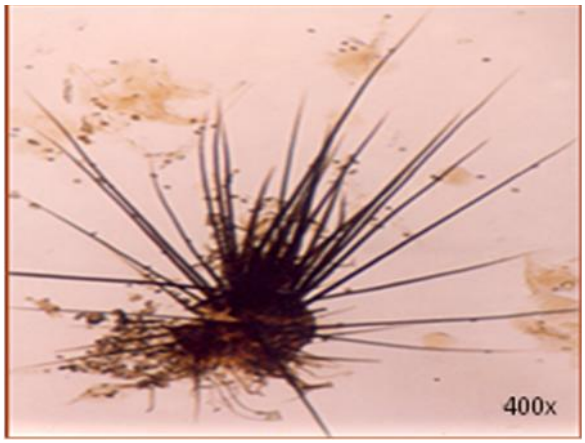
Mucor racemosus



Rhizopus stolonifer



Cladosporium sp.

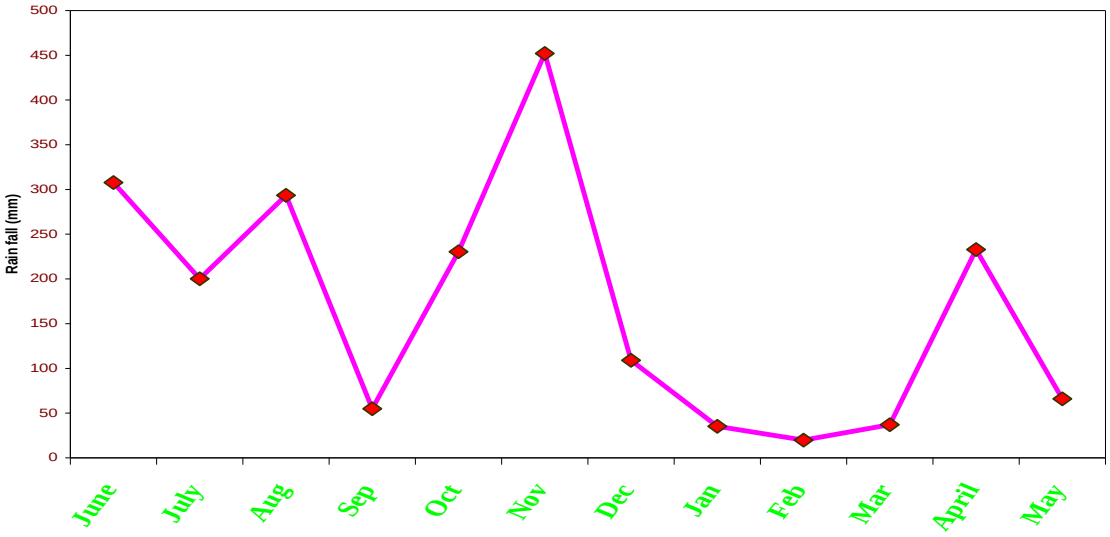


Chaetomium globosum

Fig. 3. Microscopic Observation of isolated fungal species

Monthly variation in rainfall (mm)

The annual rainfall of Yercaud recorded was 2038.7 mm in the one year of survey (June `2010 to May `2011). There was minimum rainfall during January (35.3 mm), February (19.8 mm) and March 2011 (37 mm). Maximum rainfall of 452 mm (Nov. `10) and 307.4 mm (June. `10) were recorded during the study period. The monthly mean rainfall for the one year was 169.89 mm. (Fig.4)



Month (June-2010 to May-2011)

Fig.4 Monthly variation in rainfall recorded at Yercaud Hills

Monthly variation of pH

The overall pH observed was in the range of 5.2 to 6.8 in all the stations of Yercaud hills during the study period. The maximum pH recorded was 6.8 (May `11 and Mar, 11) in station 1 and station 3 respectively, and the minimum observed was 5.2 (Oct, 10) in station 2. The average pH recorded in the stations of Yercaud hills was respectively 6.18, 6.11 and 6.16.

Among three stations studied, maximum pH was recorded during summer and the minimum during monsoon. However, the pH is slightly varied among the stations and both maximum and minimum pH was observed in Yercaud hills during the study period. (Fig.5)

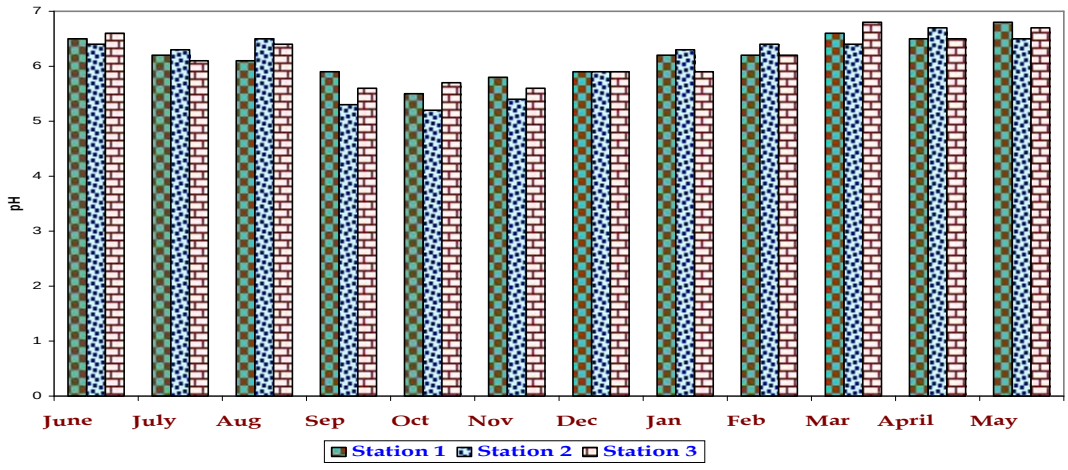


Figure 5. Monthly variation of pH recorded in all three stations of Yercaud Hills

Monthly variation of electrical conductivity

The measures of electrical conductivity show the total amount of soluble salts present in the soil. It is the most common measure of soil salinity. The electrical conductivity values of Yercaud hill ranges from 0.11mMhos/cm to 0.14mMhos/cm. (Fig.6)

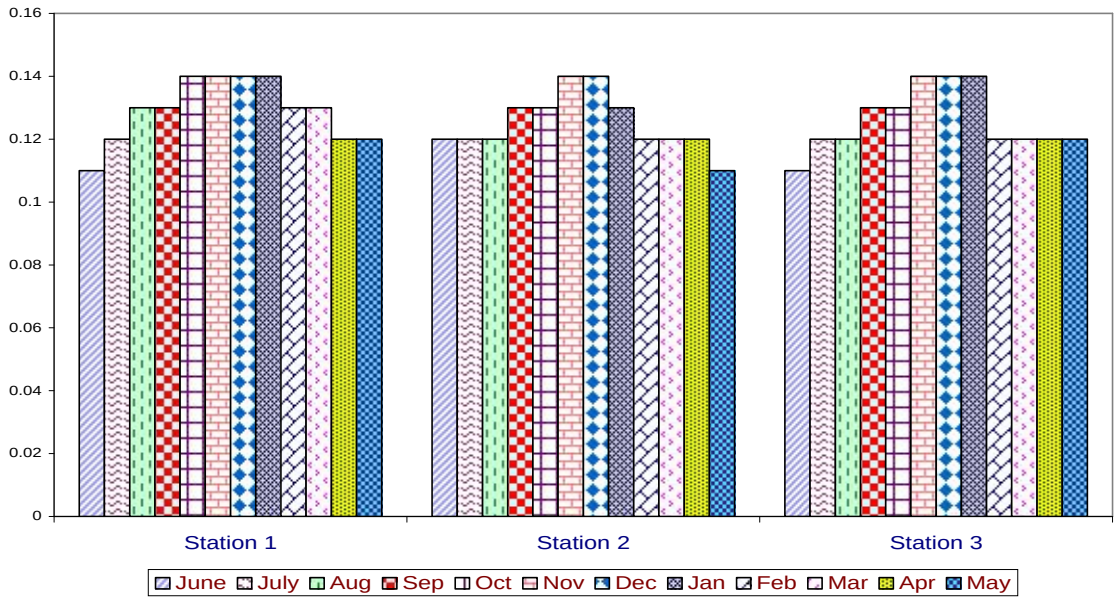


Figure 6. Monthly variation of EC recorded in all three stations of Yercaud Hills

Discussion

Mycologists have long been fascinated with the morphological and functional variety of terrestrial and freshwater fungi. Fungi of forest ecosystems are tremendously diverse and play wide-ranging roles in forest ecosystem processes. Understanding the role of fungi in forest ecosystem processes is a key to successful characterization of biological resources. In addition, fungal biodiversity studies will contribute to the discovery and characterization of fungal resources, provide insight into their sustainability, and help slow the loss of these biological resources (Rossman *et al*. 1998). In that context the present study also gave much valuable information about fungal diversity in three different stations in Yercaud tropical hills, Tamil Nadu, India.

The fungal density, species diversity, percentage occurrence of the distributed fungi and the effect of various environmental parameters on the fungal distribution were studied in Yercaud tropical hills. The fungal species are cosmopolitan in distribution, their population in the particular habit, due to fluctuation in the Physico – chemical parameter. As defined by Joffe (1949), Soil is a natural body consisting of layers (horizons) of mineral constituents of variable thicknesses, which differ from the parent materials in their morphological, chemical and mineralogical characteristics. Soil means a substrate for plant growth which performs many functions essential to life.

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Subject: Biodiversity

Quick Response Code

DOI:10.22192/ijarbs.2016.03.12.012

How to cite this article:
A. Anand and R. Senthil kumar. (2016). Influence of physico chemical parameters on the fungal diversity in Yercaud hills in Salem district, Tamil Nadu, India. Int. J. Adv. Res. Biol. Sci. 3(12): 91-99.
DOI: http://dx.doi.org/10.22192/ijarbs.2016.03.12.012