World Applied Sciences Journal 19 (9): 1268-1272, 2012
ISSN 1818-4952

DOI: 10.5829/idosi.wasj.2012.19.09.1577

Study on Diversity and Frequency of Macrofungi in Deciduous and Mix Forestation of Northern Iran (Case Study Golestan Province)

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Abstract: Fungi are the important components of forest ecosystems that influence on the life of other organisms. Macroscopic fungi vary in broadleaf and conifer forests. In order to identify Macrofungi on forest floor in *Alnus subcordata* and *Cupressus sempervirens* forested masses Plats 0.6 ha were selected in the Shastkalateh forest, Gorgan (North of Iran). Macrofungi collected in summer and autumn season (2010), they were identified according to macroscopic, microscopic characteristics and reliable sources as well. 11 species consist of: *Boletus queletii, Collybia confluens, Coprinus atramentarius, C. Lagopides, C. micaceus, Hygrocybe laeta, Lepiota cristata, L. naucina, Mycena polygramma, M. pura, Psathyrella candolleana* Were collect on *Cupressus sempervirens* in compare 7 species consist of: *Collybia sp, Cystoderma amianthinum, Lepiota brunneoincarnata, L. naucina, Mycena abramsii, Macrolepiota gracilenta, Psathyrella candolleana* collected in *Alnus subcordata* mass. In order to find relationship between type of mass and the diversity macrofungi, pH of soil under each specimen was measured by PH meter paper and PH meter device in lab. PH level in *Cupressus sempervirens* mass and in *Alnus subcordata* mass were found between 7-8 and 6.5-7.5 respectively.

Key words: Soil PH · *Cupressus sempervirens* · *Alnus subcordata* · Macrofungi · Shastkalateh Gorgan (Iran)

INTRODUCTION

Fungi are one of the most important components of forest ecosystem beside with either beneficial or harmful effect. They are the second large group creature on the ground [1], found in every ecosystem in the word. It is estimated that there are 1.5 million species of fungi but only about 69000 species have been explained including. 46124 species of Basidiomycetes, Ascomycetes. Macroscopic fungi with specific fruiting organs and enough large size that are visible by naked eye grow on the ground or underground. Normally, they belong to Basidiomycetes, Ascomycetes [2].

According to Crick *et al*. [3] the macrofungi have either soft flesh or hard wood which may be edible or non edible, toxin or non-toxin.

Soil fertility can effect on beneficial in the abundance and diversity of fungi. The top horizon of still is reach in the organic material aspect. So this layer consists of high fungal population. Generally, so increases, in depth causes decrease organic material and fungi population as well. Frequency and diversity of fungi in natural forest differ from forestation area [4].

Plantations provide a habitat for diverse macro fungal communities, which vary markedly in composition from site to site. Although the precise composition of these communities is difficult to predict, there is some evidence that different functional groups of fungi may be related to environmental variables which are relatively easy to quantify [5].

Comparing diversity of macrofungi of semi-natural pine and oak woodlands in northern Britain showed Altogether, 419 species were recorded there were no differences in fungal species-richness between plantations and semi-natural woodlands or any effects of crop species age or type [6].

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Microbiological and chemical properties of 40 North German spruce (*Picea abies* [L] K.) and beech (*Fagus sylvatica* L.) stands showed type of forest caused changes on pH and therefore ratio fungi – bacteria of two stands [7].

PH is one of the most important factors in the distribution of fungi. In acidic pH, population of bacteria and Actinomycetes is low, so microbial composition is lower in this pH. Under this condition, the population of fungi is dominant and they reproduce more frequently. So when pH is acidic, the chemical changes are controlled by fungus. PH environment is highly important in metal ions. At the appropriate pH (pH=6), metal ions are released so that they are available for mushrooms. Any change in pH environment causes in changes of activity the cell enzyme. Soil pH is important for the growth of fungi and the solution of some elements of fungi's environment. Therefore, they will be absorbed more easily. PH is also effective in cells' penetration. Under high pH, cell's penetration reduces [8].

Phosphorus, pH, moisture, soil type and seasons are effective in natural population of Arbuscular Mycorhizal fungi in natural ecosystems. According to [9], the number of spores of this fungus has a positive relationship with the availability of phosphorus and pH of soil. The population of Arbuscular Mycorhizal fungi is less in summer than winter. Study on diversity of Ectomycorrhizal fungi in different ages pure mass plantation pinus kesiya with showed that mycorrhizal biodiversity is correlated with the age of pine [10]. The maximum number of fungi is observed in old populations and mycorrhizal fungi reach the peak in the rainy season. There is a positive relationship between the number of ectomycorrhizal and moisture, soil pH, N, P, K and organic matter of soil. Meyer and Wooldridge [11] showed that there isn't any difference between the sporulation, pH and soil organic carbon.

According to Gray [12], the availability of some fungi such as Nematophagous is influenced by pH, soil moisture and other soil factors, but the formation of Conidia is affected by organic material. Many saprophytic fungi grow in pH of 7-8 and optimum pH for the growth of ectomycorrhizal is 5-6 [13].

Different species can grow in different pH *Aspergillus* species grow well in alkaline pH whereas *penicillium* grows best in acidic pH condition [14].

Based on the studies of Gooranson *et al.* [15] diversity of Arbuscular mycorrhizal fungi and fine endophyte in 4 grass species in an oak forest, there was a significant negative correlation between the establishment of Arbuscular mycorrhizal and acidic soil. Arbuscular fungi facilitate the availability of other plants in acidic soil.

Regions covered with trees such as *picea abies*, *pinus sylvestris* provides conditions for the growth of a variety of macrofungi spices. A total 343 indentified species, 171 and 90 species distributed in the mass of pine and in the mass of picea respectively. There is a significant relationship between the increase of fallen trees species and the number of Saprophyte Fungal. A similar relationship was found between the species of Ectomycorrhizal Fungal and trees species in the plot. The goal of this research was to identify diversity of macrofungi in *Alnus subcordata* and *cupressus sempervirens* [5].

MATERIALS AND METHODS

Site of Study: The study area was conducted in Golestan province (Gorgan) - northern Iran-, Gorgan scientific research forest consist of a 25 years old mixed Cupressus sempervirens (80%) and parrotia persica (20%) mass and pure Alnus subcordata mass forestations (longitude 36° 45' N, Latitude 54° 23'E). These forestation area located region with Caspian climate and average annual rainfall of 649 mm, average annual temperature of about 12 and average humidity of 76.5%.

Collection and Identification: In order to collection macrofungi, 2 plots about 0.6 hectare of mix Cupressus and Alnus forestation were chosen. Sampling has been done during summer and fall, four times each season in both plots specimens at different stage of development would be collected by digging with 10 cm of soil under them and would be removed from the ground with a great care to avoid damage to the base and other fragments. Soil and other brushwood were removed using a soft brush. Then pH was determined by PH meter paper.

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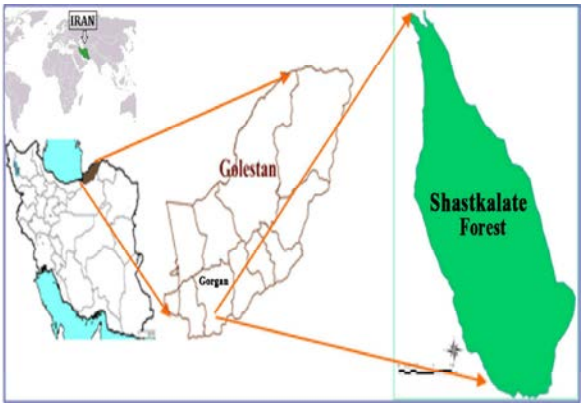

Fig. 1: The location Shastkalate Gorgan of Golestan province in Iran

Samples were placed and kept in a separate plastic bag blowing them to avoid damaging and mixing. Took photos and a permanent marker was used to make note indicating the place where it is collected, color and characteristics of habitat such as: type of forest, altitude of collection site, etc. during the collection. Samples were taken to the laboratory in basket for microscopical examination and identifications. Upon returning from collecting trip, Specimens were examined in the laboratory and identified using existing taxonomic treatments. Each species was described according to the collected specimens and identified based on Smith (1979); Singer (1986); Moser (1983) and according to other.

Literatures, as well [16, 17, 18]. Measurements and drawings were made from slide preparations stained with cotton blue- lacto- phenol contains 100 ml. Lacctophenol, 2ml 1% aqueous solution of cotton blue, by Olympus light microscope (BH2).

In order to determine of acidity of soil in the laboratory, 20 gram of soil and 100 cc of distilled water are poured in an Erlenmeyer flask, shaker about 20 min. acidity was determined using a digital PH meter.

RESULT

A total 16 macro fungi species collected during of study in the study area, 9 species found just on mix cupressus and iron wood mass in compare 5 species have been found just in alder mass 2 species were found in both masses (Table 1). The most of collected macro fungi belonging to family Agaricaceae consist of 5 Species, in compare Boletaceae and Hygrphoraceae with 1 Species were the less. In Alder mass the most diversity of macro fungi belonging to family Agaricaceae (3 genus and 4 species) in compare Mycenaceae, Psathyrellaceae and Tricholomataceae had the less diversity (1 genus and 1 species).

In mix Cypress mass the most diversity of macro fungi belonging to family Psathyrellaceae (2 genus and 4 species) in compare Boletaceae, Hygrphoraceae and Tricholomataceae had the less diversity (1 genus and 1 species) (Table 1). The species of *Lepiota naucina* and *Psathyrella candolleana* have been found in the both masses.

Study on pH of soil in 2 study masses showed that, PH differ a range from 6.61-8. Comparing pH of 2 masses shows pH in Alder mass pH was less (6.61-7.75 in Alder, 7.39-8 in mixed mass).

Correlation of pH and macrofungi species is given in Fig. 2. In Alder mass the highest and lowest of soil PH belonging to *Collybia sp* (7.75) and *Cystoderma amianthinum* (6.60) respectively. In mixed mass the more pH of soil belonging to *Coprinus atramentariu*s, (Fig. 3)

Coprinus micaceus and *Lepiota cristata* (8) and *Lepiota naucina* grew in the less pH (7.39).

Comparing of number of collected species in 2 season sampling showed, the most species can be found during fall season, *Psathyrella candolleana* was the only species that found during summer.

7 species of collected macro fungi were edible that are as follows: *Collybia confluens, Coprinus atramentarius, Coprinus micaceus, Cystoderma amianthinum, Lepiota naucina, Macrolepiota gracilenta, Psathyrella candolleana.*

In compare there are 2 poisons species, consist of *Lepiota brunneoincarnata* and *Lepiota cristata*. *Boletus queletii* is the only Ectomycorrhizae in our study area found on mixed mass.

DISCUSSION

Diversity of macro fungi in two deciduous and mixed masses showed the more variation in species can be seen in mixed forest, but the more frequency of macrofungi have been seen in Alder pure mass. It can be related variations of substrate in mixed forest. In a study in an area in Canada found the macro fungal flora of the deciduous forest was composed mainly of many infrequent species, whereas coniferous forests had few, but very frequent, macrofungi [19].

Table 1: Total identified of macrofungi in *Alnus subcordata* and *Cupressus sempervirens* masses

Row	Fungi	Family	*Cupressus sempervirens*	*Alnus subcordata*	Edible	Inedible	Poison	Mycorizal
1	*Boletus queletii*	Boletaceae	*			*		*
2	*Collybia confluens*	Tricholomataceae	*		*			
3	*Collybia sp*	Tricholomataceae		*				
4	*Coprinus atramentarius*	Psathyrellaceae	*		*			
5	*Coprinus lagopides*	Psathyrellaceae	*			*		
6	*Coprinus micaceus*	Psathyrellaceae	*		*			
7	*Cystoderma amianthinum*	Agaricaceae		*	*			
8	*Hygrocybe laeta*	Hygrphoraceae	*			*		
9	*Lepiota brunneoincarnata*	Agaricaceae		*			*	
10	*Lepiota cristata*	Agaricaceae	*				*	
11	*Lepiota naucina*	Agaricaceae	*	*	*			
12	*Macrolepiota gracilenta*	Agaricaceae		*	*			
13	*Mycena abramsii*	Mycenaceae		*		*		
14	*Mycena polygramma*	Mycenaceae	*			*		
15	*Mycena pura*	Mycenaceae	*			*		
16	*Psathyrella candolleana*	Psathyrellaceae	*	*	*			

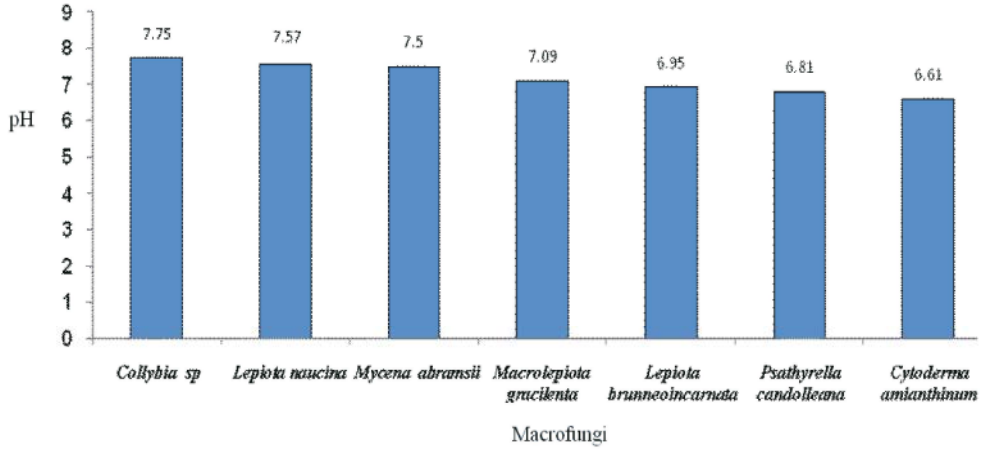

Fig. 2: Acidity of growth location of Macro fungi in *Alnus subcordata* mass

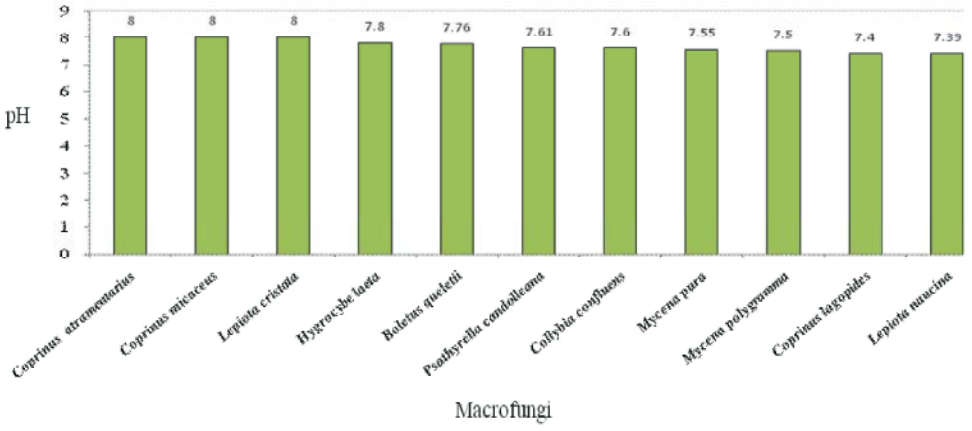

Fig. 3: Acidity of growth location of Macro fungi in *Cupressus sempervirens* mass

Changes in Type of forest, especially forestations with new non endemic tree species in an area affecting on pH and other environmental factors, these changes can beneficial for some organisms or harmful for others, hence it is not so surprising differences and more variation of macro fungi in a mixed forestations area including a native species (Iron wood) and non native species Cypress in compare of Alder, a native pour masses, It is understood and mentioned in some Iranian and non Iranian studies [20, 21, 22].

As a food supply, in despite of high species variations of edible mushrooms (8 species) and low poisonous species (2 species), macrofungi collection by local people are not common. None of them are known as edible wild mushrooms in Golestan province.

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