Journal of Physics: Conference Series

PAPER • OPEN ACCESS

The effect of Soil properties on the Biological Diversity of Fungi in Soil University of Anbar.

To cite this article: Wijdan Ahmed Ali *et al* 2021 *J. Phys.: Conf. Ser.* **2114** 012068

The effect of Soil properties on the Biological Diversity of Fungi in Soil University of Anbar.

Wijdan Ahmed Ali[1*], Rahaf Hameed Hussein[2], and Wafaa Tali Radef[3]

[1*] Department of Biology, College of Science, University Of Anbar, Ramadi, Iraq

2-Student at gifted school in Al Anbar, Iraq.
Rahaf.aussein@iraqiggc.edu.iq

3- University Of Anbar, Headquarter, Ramadi, Iraq

Waf-tal-1982@uoanbar.edu.iq

*Corresponding author E-mail: sc.wejahmed@uoanbar.edu.iq.

Abstract. Microorganisms are a varied collection of organisms that make up around 60% of the earth's biomass. The ratio of fungal to plant species is estimated to be around 6 to 1. In order to extrapolate worldwide estimates of 1.5 million fungal species, this ratio is utilized. Because of the activity of soil organisms, soils are very complex systems with numerous components performing many roles. Soil microflora is essential for assessing soil conditions and encouraging plant development. Microorganisms are helpful in enhancing soil fertility because they participate in a variety of biochemical transformation and mineralization processes in soils. Organic matter in the soil that impacts the physical, chemical, and biological characteristics of the soil and serves as a complementary medium for biological processes and life support in the soil environment. Microbes have a very significant role in biodiversity. Organic matter in the soil that influences its physical, chemical, and biological properties and acts as a complimentary medium for biological activities and life support in the soil environment. Microbes play an important part in biodiversity. The study demonstrated the importance of pH and soil texture on the variety of soil fungus species. Three clones were grown on PDA at 28 C^0 (7 days) as *Aspergillus sp.*, *Penicillium sp*., and *Fusarium sp.*

Keyword: Soil fungi, diversity, fungal species, soil properties.

1.Introduction

Soils are one of the greatest reservoirs of biodiversity, with biological richness many times that of the surface. Microorganisms' biochemical activity has an impact on soil fertility production and maintenance. Fungi play an important part in ecosystem function, owing to their ability to decompose plant wastes. Quantitative and qualitative improvements in soil organic matter may be seen mostly in agro environments with a diverse range of fungus [1]. Decomposition of lignin is similar to that of fungus. Fungi make up a large part of the soil microbiota, often accounting for more biomass than bacteria depending on soil depth and nutritional circumstances [2]. The amount and type of organic matter in the soil, as well as other soil and climatic variables, surface vegetation, and soil texture, all have an impact on the dispersal of these organisms [3]. The following parameters are measured: pH, electrical conductivity, soil moisture, organic carbon, nitrogen, phosphorus, potassium, iron, manganese, copper, and zinc. The atomic absorption spectrophotometer was used to assess macronutrients including nitrogen, phosphorus, potassium, and organic carbon, as well as micronutrients like copper, iron, manganese, and zinc. The major variables influencing fungal population and variety are soil pH, organic content, and water. In natural soil, organic carbon regulates microbial development to a significant extent. It is an important element in the regulation of the nitrogen, phosphorus, and sulfur cycles [4].

pH, electrical conductivity, moisture content, macronutrients (nitrogen, organic carbon, phosphorus, potassium), and micronutrients (Fe, Mn, Cu, and Zn) were also significantly higher and critical for fungal development. Mold and sporulation development, as well as that of other microorganisms, are significantly hampered in the absence of any of these. While magnesium, manganese, and iron are necessary in trace levels, they are also essential [5].

Fungi thrive in soil because of their extraordinary adaptability and ability to take on a variety of shapes in response to demanding or unfavorable conditions. They are capable of breaking down various types of organic molecules, degrading soil components, and therefore maintaining the carbon and nutrition balance due to their capacity to produce a wide range of extracellular enzymes [6]. Fungi degrade organic materials to generate biomass, CO2, and organic acids. Many fungi can act as biosorbents by collecting toxic metals such as cadmium, copper, mercury, lead, and zinc in their fruiting bodies. Fungal diversity and activity are influenced by a variety of biotic (plants and other animals) and abiotic (soil pH, moisture, salinity, structure, and temperature) variables [7].

Fungi can survive in a wide range of pH and temperature settings and may be found in almost every environment. Soil fungi can be divided into three functional groups: biological controllers, ecosystem regulators, and species involved in organic material breakdown and chemical transformations. Ecosystem regulators are responsible for the formation and modification of soil structure by influencing the dynamics of physiological processes in other species' habitats' soil environments. Biological regulators [8].

Soil physical, chemical, and biological processes occur and define functions that provide a variety of services within ecosystems, such as organic matter turnover and symbiotic and non-symbiotic atmospheric nitrogen fixation, Soil physical, chemical, and biological processes occur and define functions that provide a variety of services within ecosystems, such as organic matter turnover and symbiotic and non-symbiotic atmospheric nitrogen fixation. Fungi are vital for the proper functioning of soil ecosystems and agricultural soils; they participate in a variety of critical processes such as organic matter decomposition and elemental release via mineralization Table 1. In natural settings, 1.5 million fungal species are thought to exist [9]. As decomposers, soil fungus play an essential role in the soil ecosystem. There are approximately 75,000 distinct species of soil fungus that may be found all over the world. Fungi are one of the most common groups of organisms found in soil, and they have a significant impact on ecosystem structure and function, as well as a wide range of ecological activities. As a result, there is a growing interest in evaluating soil biodiversity and biological diversity [10].

This research aims at the frequency of fungal communities in soils with a wide range of physical and chemical properties. Because pH and soil texture can all have a significant influence on soil fungus diversity, the objective of this study was to assess the impact of soil parameters on fungal biodiversity.

Table 1: Soil Fungal Biodiversity [10]

Role of soil	Ecosystem services	Factors changing	Main types of soil
Saprotrophic mycorrhiza pathogens	Organic matter	Soil degradation	Agricultural
Enzyme and metabolite production	Nutrient cycling	Soil contamination	Horticultural
Biocontrol agents	water	Nutrient deficiency and soil properties (salinity/drought)	Grasslands Forests

2. Experimental part

2.1 Collection of soil Samples:

This study was conducted in February 2020 at the Biology Department of the University of Anbar, and three places for soil sample were chosen: The University of Anbar's garden, the University of Anbar's campus, and the University of Anbar's campus. From each location, 25 random soil samples were taken at depths ranging from 0 to 20 cm, mixed well to form composite samples, then collected in sterile containers, sealed, and carefully put in sterile polyethylene bags before being transported to the laboratory. To produce soil samples with tiny particles, samples were combined and sieved twice to eliminate different contaminants, big stones, and debris [11].

2.2 Measurement pH of soil:

The pH of the samples was measured in a 1:5 soil water suspension using an electronic digital pH meter [12].

2.3 Streptomycin stock solution:

5 mg streptomycin was dissolved in 1000 mL DW to achieve a final concentration of 0.5 mg/L, which was then stored in the refrigerator for up to one month [13].

2.4 Dichloran stock solution

Dissolved After adding 10 mg of dichloran to 1000 mL of distilled water and stirring for 5 to 10 minutes, the final concentration was 0.1mg/L. The medium was poured [13].

2.5 Isolation of soil Fungi

Serial dilutions to 10^{-6} were made from 10 g of soil in 90 ml of sterilized distilled water [14] Each dilution was smeared with a 0.1 mL aliquot on PDA. Cultures were cultured at 28°C for 7 days, then analyze their development and Several additional PDA subcultures. Slants were kept in the refrigerator to develop and be utilized for cultural and morphological identification.

2.6 Identification of soil fungi

To identify the clones culturally and microscopically, taxonomic guidelines and conventional techniques were utilized [15], [16].

2.7 Determination of soil texture:

To assess the texture of a soil sample (sand, loamy soil, and clay), 100 g of soil sample weight was required, which was calculated using the air-dry soil weight and moisture correction factor [17].

3. Results and Discussion:

Soil texture as shown in the Table 2, the current investigation found a significant variation between soil types and texture, Clay loamy soil and texture were used to isolate (I_1-I_3) clones from three different locations.

Table 2: Texture, PH and types of Soil.

Location of soils(University of Anbar)	pH	Clay%	Loamy%	Sand%	Texture
S1	6.4	472.9	378.3	148.6	Clay loam
S2	6.8	311.7	404.2	85.1	Clay loam
S3	6.2	644	200	156.0	Clay loam

Soil fungal diversity can be influenced by a number of factors, including soil PH, texture, organic matter content, and sample depth Table 2. Soil pH had a moderate influence on fungal diversity [18]. Soils are made up of particles that combine to form large particles that vary in size and shape and are influenced by soil water and air movement, nutrient availability, bioactive compounds, and elements (C, N, and P) [19], [20].

Morphologically and Microscopically Examination of clones in all studies, the fungal species (clones) from different sites were analyzed by identifying the morphological and microscopically characteristics of this species using lactophenoal cotton blue staining technique under light microscope(40X) and analysis was carried out using taxonomic guide of fungi characteristics such as diameter, color, shape, and size were shown in Figure 1, Table 3 [15],[16].

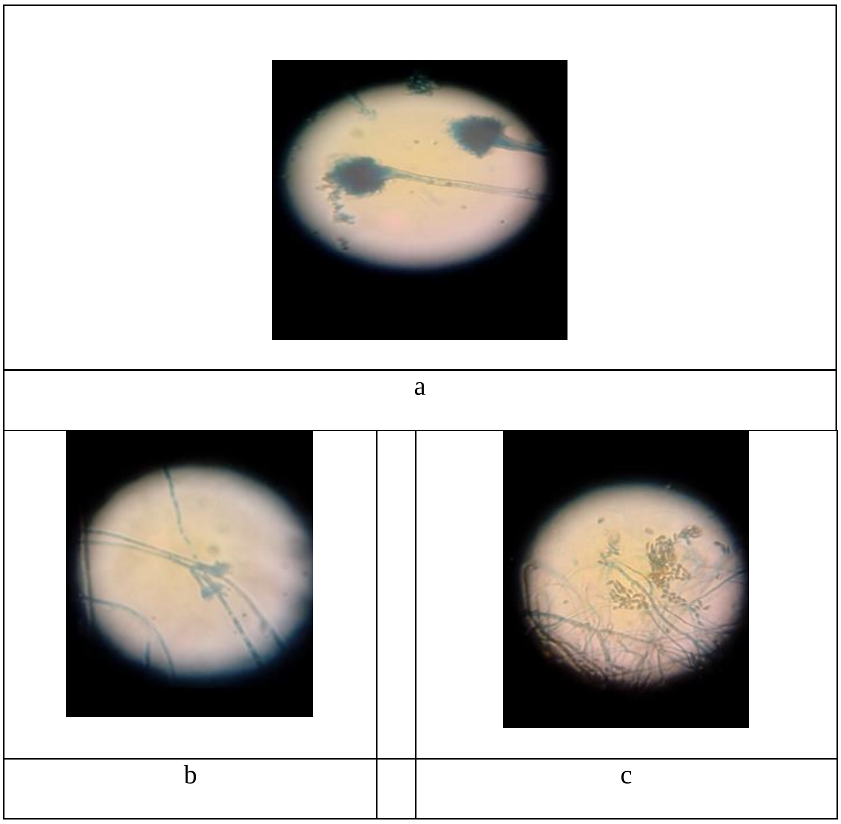

Figure 1. Microscopically observation of soil fungi. a) ***Aspergillus sp* .   b *) Penicillium sp*. c)** ***Fusarium sp***

Characteristics of clones from different sites of soils in all investigations, (3) clones as I_1, I_2,I_3 various fungus species from distinct soil locations were used. The morphological and microscopically features of these clones were identified through analysis and displayed. All clones share characteristics such as diameter, color, shape and size Table 3.

Table 3: Characteristics of Clones from different sites of Soil.

Clones	Diameter (mm)	Characters
I_1	3	*Aspergillus*, colonies were yellow-green with white apron at the margin, conidiophores are long, uniseriate conidia are round, smooth and form long chains
I_2	1.5	*Penicillium*, colonies were green with cottony upper surface, white – brown on the reverse side , conidiophores was long, thick walled and hyaline, conidial head was bluish with an irregular shape.
I_3	2.0	*Fusarium* ,colonies are pink with white on the surface and the reverse side was brown in coloration, microconidia was long, thick walled and hyaline,the conidiophores near the vesicle.

There are several species of soil fungus. demonstrates the findings of a study of the biodiversity of three unique soil types Figure 1. Which identified 38 distinct fungus species grouped into three genera I_1, I_2, and I_3 were the total number of species discovered in samples. Organic matter decomposers were the most common soil fungus identified, although there were other fungal species present, including *Aspergillus sp*., *Pencillium sp*., and *Fusarium sp*. three different species Table 3. This result may also be compared to the findings of writers from all over the world, where such species were found in Indian soil and litter samples from Thailand's Forest Reserve and litter samples from different forest types in China [21].

Many taxa are known to be related. In Serbia, fungi from the genera *Penicillium, Aspergillus,* and *Fusarium* have been discovered in reservoirs of lakes and rivers. In rivers and lakes, similar fungal colonies have been identified [22]. This was expected since soil fungi spread quickly and have a diverse spectrum of thermophilic and heat-resistant characteristics [23]. It is well known that the composition of fungal communities is more comparable in soils with similar soil moisture, organic matter, pH, and electrical conductivity [24], [25], [26].

4. Conclusions

In agriculture, soil health conditions have an influence on the environment. Furthermore, research is required to establish the best method to preserving fungal biodiversity in soil, taking into account fungal activities as well as ecosystem services such as pH and soil texture. It is important to have the right tools and be able to identify species while also defining their significance in the environment.

Acknowledgments

The authors are thankful to University from Anbar. This is to provide the necessary facilities for conducting the research

5. Reference

[1]Ladislav Holík , Lukáš Hlisnikovský , Roman Honzík , Josef Trögl,Hana, Burdová and Jan Popelka .2019. Soil Microbial Communities and Enzyme Activities after Long-Term Application of Inorganic and Organi Fertilizers at Different Depths of the Soil Profile. *Sustainability*, 11, 3251; doi:10.3390/su11123251.

[2] Kadri Koorem , Antonio Gazol , Maarja O¨ pik , Mari Moora , U¨ lle Saks , Annika Uibopuu , Virve So˜ber and Martin Zobel .2014. Soil Nutrient Content Influences the Abundance of Soil Microbes but Not Plant Biomass at the Small- Scale. *PLOS ONE. | Volume 9 .Issue 3*

[3]Václav Voltr , Ladislav Menšík , Lukáš Hlisnikovský , Martin Hruška , Eduard Pokorný and Lubica Pospíšilová .2021. The Soil Organic Matter in Connection with Soil Properties and Soil Inputs.*Agronomy*, 11, 779. https://doi.org/10.339 /agronomy11040779

[4]Davi Lopes do Carmo, Laís Botelho de Lima and Carlos Alberto Silva.2016. SoilFertilitand Electrical Conductivity Affected by Organic Waste Rates and Nutrient Inputs. *Rev Bras Cienc Solo*;40:e0150152

[5] Sorina-Simona Moraru, Antoaneta Ene, and Alina Badila.2020. Physical and Hydro-Physical Characteristics of Soil in the Context of Climate Change. A Cas Study in Danube River Basin, SE Romania. *Sustainability*, 12, 9174;doi:10.3390/su12219174.

[6]Idowu Ezekiel Olorunfemi , Johnson Toyin Fasinmirina and Funke Florence Akinola.2018. Soil physico-chemical properties and fertility status of longterm. land use and cover changes: A case study in Forest vegetative zone of Nigeria. / *Eurasian J Soil Sci*, 7 (2) 133 – 150.
[7] Jackie Aislabie, Julie R. Deslippe. 2013. Soil microbes and their contribution to soil services. In Dymond JR ed. Ecosystem services in New Zealand – conditions and trends.
[8] Magdalena F.,Silja E.H.,Marta B. and Malgorzata J. 2018 . Fungal Biodiversity and Their Role in Soil Health. *Micro* . doi org/10.3389 .
[9] Alemu Lelago,Tadele Buraka.2019.Determination of physico- chemical properties Zone, Southern Ethiopia**.** *Eurasian J Soil Sci* , 8 (2) 118 – 130.
[10]Lijbert Brussaard.2017. Biodiversity and Ecosystem Functioning in Soil . *Ambio* Vol. 26 N0.8
[11] Gatazka A. and Grzadziel j .2018 .Fungal Genetics and Functional Diversity of Microbial Communities in the Soil under Long-Term Monoculture of Maize Using Different Cultivation Techniques . *Front Microbiol.* 9: 76.
[12] Liu, D., Liu, G., Chen, L., Wang, J., and Zhang, L. 2018. Soil pH determines fungal diversity along an elevation gradient in Southwestern China. *Sci China Life Sci* 61, https://doi.org/10.1007/s11427-017-9200-1
[13]Cotty P.J. 1994. Comparision of four media for the isolation of *Aspergillus* flavus group Fungi. *Mycopathologia* 125:157-162.
[14]Waksman S.A.1922. A method for counting the number of fungi in the soil.*J. Bacteriol*. 7: 339- 341.
[15] Watanabe T. 2012. Quintile Forecasts of Financial Returns using Realized graph Models *the Japans Economic Review, Vol*. 63, No. 1
[16] Alexopoulos C.J., Mims C.W John wiley and sons,. New York.4:868 ., and Blackwell M .1996. Introduction Mycology.
[17]Milford , and Murray H .1997. Introduction to Soil and Soil Science Laboratory. Exercises Kendall /Hunt Publishing Company , Dubuque ,Iowa
[18] Rasulić N., Delić D., Stojković-Srbinović O., Kuzmanović Đ., Jošić D. 2012. Microbiological properties of rankers in the region of Western Serbia. Field and Vegetable Crop Research, 49: 173–176.
[19] Rosa María Arias Mota and Gabriela Heredia Abarca.2020. Diversity of soil culturable fungi in the tropical montane cloud forest of Veracruz, Mexico. DOI:10.33885/sf.2020.50.1290 , Vol. 50:e1290.
[20] Comi L .´, Rankovi´ B. , Novevska V. and Ostoji´ A. 2010 . Diversity and dynamics of the fungal community in Lake Ohrid . Vol. 9: 169–176, doi: 10.3354/ab00248 (5): 559-566
[21] Puangsombat p ., Sangwanit U. and Marod D. 2010 .Diversity of Soil Fungi. in Different Land Use Types in Tha Kum-Huai Raeng Forest Reserve, Trat Province .*Kasetsart J. Nat. Sci.* 44 : 1162 – 117
[22] Sonja T. Ž. , Ljiljana N. , Radivoje J. , Milivoj B. ,Vladimir C., Mirjana L.,and and Jelica V.2017. Fungal diversity as influenced by soil characteristics. ISSN1392-3196 / e-ISSN 2335-8947 *Zemdirbyste-Agriculture, vol*. 104, No. 4 p. 305–310 DOI: 10.13080/z-a.2017.104.039
[23] Gams W. 2011. Biodiversity of soil-inhabiting fungi. Biodiversity and conservation. 16(1): 69-72
[24] Kim, J. M., Roh, A. S., Choi, S. C., Kim, E. J., Choi, M. T., Ahn, B. K .2016 . Soil pH and electrical conductivity are key edaphic factors shaping bacterial communities of greenhouse soils in Korea. *J. Microbiol.* 54, 838–845.
[25] Sorina-Simona Moraru, Antoaneta Ene, and Alina Badila.2020. Physical and Hydro-Physical Characteristics of Soil in the Context of Climate Change. ACase Study in Danube River Basin, SE Romania. *Sustainability* , 12, 9174; doi:10.3390/su 12219174.
[26] Miguel Rosas-Medina, Jose G. Maci , Vicente and Meike Piepenbrin Diversity of Fungi in Soils with Different Degrees of Degradation in Germany and Panama. *Mycobiology , Vol.* 48, NO. 1, 20–28.