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Review Algae and Fungi on Soil Ecosystem

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Abstract
Many types of microorganisms spread in the soil, such as bacteria, viruses, fungi, algae, and protozoa. The soil contains many types of algae, which differ in their growth requirements, such as temperature and acidity. Soil fungi are microscopic plant-like cells. Soil fungi, along with soil bacteria, form the beginning of the soil food web, which improves soil functions and supports the survival of other organisms. Soil fungi are abundant in soils with low acidity, perennial plants, and organic residues that need a long time to decompose Algae and fungi are important and beneficial to the soil, and some of them are affected and benefit from the soil environment in a way that contributes to the formation of an integrated ecosystem that contributes to biological and life diversity. Green algae and diatoms usually dominate over other algae in the soils.

Keywords: Algae, Fungi, Green Algae, Diatoms, Decomposers Fungi

1. Introduction

1.1 Algae

Algae spreads in all types of soils, but their numbers are less than the numbers of bacteria and fungi because of their fundamentally small numbers, they did not receive much attention from the first microbiologists. Algae are distinguished from other microorganisms in that they are autotrophic organisms that can perform the process of metabolism Photosynthesis, from which you can get energy. Algae spreads in wet areas Exposed to light, and it was also found that some strains can exist under the surface of the soil. In general, the algae present in the soil are either unicellular or ribbonlike, and they are generally Simpler and smaller in structure than aquatic algae, and the most famous of the major groups of algae scattered in the soil [1].

- Green algae Chlorophyta
- (Bacillariophyta) Diatoms
- yellow-green algae Xanthophyta
- Blue-green algae Cyanophyta.

Green algae and diatoms usually dominate over other algae in the soils of the regions temperate, while blue-green algae predominate in the soils of warm regions with its ability to self-nutrition, which is due to the possession of chlorophyll pigment [2]. The algae need Nitrogen, phosphorous, potassium, magnesium, sulfur, iron and some trace elements [2]. Carbon gets it from the atmosphere in the form of CO2, and some algae have the ability to feed non-self when they live under the surface of the soil away from the light [4]. As they resort to the analysis of materials Organic, but even these algae have little activity in the absence of light, and their activity increases with the presence of light and return to selffeeding [5]. Algae spread in the surface layer of soil and rocks. Although the presence of some types of algae that can exist at depths of 50-100 cm below the surface of the soil, but their numbers are affected by soil moisture. They can be seen in large numbers in moist soils some algal populations are greatly affected by soil pH, for example, the presence of diatoms in acidic soils, while it increases in neutral and base soils, and pH = 6 is considered a limiting factor to spread approx. In the case of blue-green algae, 10-7 pH is considered the best range for its growth [6]. Green algae are less affected by soil pH and moderate temperatures are the best the temperature is suitable for algae growth, so its numbers increase in the spring to a basic degree, and freezing limits the temperature [7]. The growth of these organisms, as algae is affected by the herbicides that are used to kill weeds, and can attack algae by bacteria, fungi, protozoa, nematodes and earthworms [8].

Soil fungi are microscopic plant-like cells, where these cells are single or in the form of long filament-like structures, soil fungi, along with soil bacteria, form the beginning of the soil food web, which improves soil functions and supports the

survival of other organisms, and soil fungi also grow Slowly in the soil, soil fungi are abundant in soils with low acidity, perennial plants, and organic residues that need a long time to decompose [9].

Here are some of the benefits of fungi found in the soil:

1. Soil improvement: Fungi preserve the carbon in the soil and protect it from harmful factors, making it a key part of what is known as the carbon cycle [10].
2. Resist drought: Fungi help plants to withstand drought, as they moisturize plants by activating some plant cells [11].
3. Plant nutrition: Soil fungi contribute to the supply of plants with many different nutrients, such as copper, phosphorous, potassium, iron, zinc, calcium and other elements [12].
4. Protecting plants from diseases and combating them: Fungi help plants to fight various diseases, through many ways; Like penetrating root cells with branching structures, these fungi also protect the roots, protect them from various pathogens, and provide them with antibiotics [13].

2. Algae Characteristics

2.1 Green algae: Chlorophyta Green algae have the following Characteristics [14]

1. They contain chromatophores, which bear a green colour Featured.
2. Contains xanthophyll and carotene tincture.
3. They exist in the form of simple unicellular or filamentous organisms.
4. It is considered the most prevalent group of algae in the soil.
5. Some of them have kinetic structures such as flagella, as in Chlamydomonas.
6. The most famous genera found in soil are *Chlamydomonas, Chlorella and Chlorococcum.*
7. Some species in the soil can reproduce by fission or sexually.

2.2 Diatoms: (*Bacillariophyta*) and are characterized by the following [15]:

1. They exist in the form of single-celled organisms or in colonies.
2. They are surrounded by an outer layer of silica Pectin and its walls consist of two shutters.
3. It is abundant in neutral and alkaline soils Temperate regions.
4. It can reproduce both sexually and asexually.
5. Most of them are immobile.
6. The most common genera are *Cymbell and Surirella*.

2.3 Yellow green algae: Xanthophyta [16]

1. It is considered the least important group of algae in the soil and the least presence of algae.
2. Its cells contain lenticular or disc-shaped pigment-bearing structures.
3. Sexual reproduction is rare in these algae.
4. The most common genera *Heterothrix and Heterococcus*.

2.4 Blue-green algae: Cyanophyta [16]

Blue-green algae are the link between bacteria and green plants, and are classified under Photoautotrophic bacteria, according to Bergey's classification, are among the representative bacteria Oxygen Phototrophic Bacteria, and its types are estimated at about2000 species, some of which are unicellular, and some of them live in the form of filamentous colonies mostly. Some of its types are distinguished by their ability to fix atmospheric nitrogen. Algae are considered blue greens. It is larger than bacteria, which are aerobic, and some of them can withstand aerobic conditions it has blue-green algae:

1. It is considered non-eukaryotic.
2. It is free of flagella and has gliding movement.
3. It contains a pigment Phycocyanin blue as well as chlorophyll and other pigments such as Phycoerythrin, in addition to carotene and xanthophyll pigment.
4. Presence of food items stored on A form of protein known as Cyanophycin.
5. can reproduce in several vegetative, sexual and sexual ways.
6. The most famous genera common in soil is *Anabaena, Nostoc and. Calothrix.*

3. The importance of algae

1. Algae play an important role in the biological weathering process of rocks, as they are the first types of plants which can grow on rocks and when they die and decompose by bacteria and fungi, so the acids the resultant can contribute to the weathering of the rocks, as well as the carbonic acid produced by the second carbon dioxide by breathing can contribute to the decomposition of rocks [16].
2. Contributes to increasing the soil's organic matter content, as it can convert inorganic compounds Organic to organic compounds [17].
3. It can contribute to the stabilization of the topsoil aggregates and reduce the potential for soil erosion [17].
4. The blue-green algae scattered in the rice fields contribute greatly to the provision of Oxygen required for respiration of rice plants.
5. Some genera of blue-green algae contribute to the fixation of atmospheric nitrogen, especially in Rice farms, where these farms are pollinated in many countries of Southeast Asia with some of those species algae, for example, the possibility of increasing rice production in many of those countries at rates ranging Between 14-20% after inoculation of farms with some genera of blue-green algae earth [18].
6. Algae are food for many organisms such as bacteria, fungi, nematodes and worms.

4. Soil Fungi and Algae

Definition of soil fungi

Soil fungi are microscopic plant-like cells, where these cells are single or in the form of long filament-like structures, soil fungi, along with soil bacteria, form the beginning of the soil food web, which improves soil functions and supports the survival of other organisms, and soil fungi also grow Slowly in the soil, soil fungi are abundant in soils with low acidity, perennial plants, and organic residues that need a long time to decompose.

5. Types of Soil Fungi [19]

The following are the main types of soil fungi according to how they obtain energy:

Decomposers fungi: These are fungi that convert dead organic matter into simpler forms of organic matter that other organisms can feed on.

Symbiotic fungi: (: Mutualists fungi), which are fungi that arise between them and the root of the plant, as it appears through the presence of fungi on the root of the plant in exchange for obtaining carbon, and the presence of fungi in the root has multiple benefits, such as dissolving some elements.

Pathogens fungi: which are fungi that live in the roots of plants to cause disease or even death.

Fungi, along with their fellow microorganisms such as bacteria, viruses, and some animals and plants, play an important and major role in soil fertility. In comparison between fungi and their companions in the soil, we find that fungi are not the largest part of the soil content of living organisms, but they are a large part of the living mass found in many Well-ventilated agricultural lands due to the relative lack of their number and at the same time their representation of a larger part of the living mass is due to the abundance of their growth in the form of thick, cohesive and intertwined fungal threads and their production of some large fruiting structures, as is the case in truffles or *Tuber maganatum* or (Trufles) Fig (1) where the fungi produce many kilograms of the terrestrial fruiting bodies [20].

Fungi dominate the rest of the living organisms in plant residues in lands rich in organic matter, where fungi are important and the first and main factor responsible for the decomposition of organic matter in acidic media, with what God Almighty has endowed with an enzymatic force capable of decomposing organic matter in the soil.

Fig 1: Truffle mushroom

Every living and growing plant has a group of microorganisms - especially fungi - that live in its root surroundings in an area called the peripheral root or the rhizosphere or located on the surface of the root called (Rhizoplane) and are responsible for many fungal diseases that affect flowering plants It is also responsible for soil fertility and the high plant production of some plants [6].

6. Fungi are classified according to their relationship to the other organisms that bind them to the soil

Obligate parasites: They compulsively parasitize on plants and animals in the soil, and work on the death and decomposition of plants and animals, adding their organic content to the soil and increasing its fertility [17].

Facultative parasites: a fungus that parasitizes its host in his presence and turns into discarded feeding in his absence [8].

True soil fungi: They play an important role in the soil in terms of destroying animal and plant bodies and their waste in the soil, and completing many vital cycles in it. Holy and botanist [21].

Root-inhabiting fungi: They are fungi that coexist with roots either on their surface or in their surroundings (Rhizosphere). These fungi play an important role in the vitality of the plant, decomposing the toxic substances coexisting with it, knowing that each plant has its own flora of fungi, whether in its root surroundings or in the mycorrhizae associated with it or on its surface as previously. Mycorrhizae symbiosis with some huge trees and take the place of root hairs in supplying the plant with water, and the plant supplies the mushrooms with ready food, and the fungus analyzes toxic substances in the soil and protects the plant from them [21].

Lignicolous fungi: As we know, lignin is a complex chemical substance that is resistant to many fungi, bacteria and termites, but there are some types of fungi that can decompose lignin and live on it with what God Almighty has endowed with enzymes that dissolve it. The type of fungi causes rotting of the roots of trees and their decomposition after their death in fields and forests. The infection of wood (by the inclusion of x and shin) comes with these fungi through airborne spores or through parts of the fungal hyphae (mycelia) that travel with the soil when trees fall on them [3].

Cellulose Decomposing Fungi: Cellulose, as we know, is a complex carbohydrate, composed of many glucose units linked together in a long complex chain linked by a (1-4) glycosidic bond in the beta position [20].

There are many fungi in the environment that decompose cellulose and live on it, such as cellulose of plant leaves and fibers of cotton, linen and kenaf. These fungi penetrate cellulose walls and destroy cellulose clothing and collectibles such as papyrus, books and paper documents. And mercury and sulfur resistant to fungi [20].

Keratin-degrading fungi (Keratinophilice fungi): This group of fungi can live on creatine such as hair, nails, and hoofs of animals, decomposing it and using it as a nitrogen source [3].

Insect-related fungi (Entomogenouns fungi): They are fungi that live on insects and parasitize them compulsorily. Domestica and these fungi are exploited in the biological resistance to insects, where the industrial infection of the insects to be combated is done with spores (the fungus) that parasitize on them and then grow on the insect and the infection is transmitted from it to another insect at the time

of mating Fig 2. Insects infect until they are biologically eliminated without the use of pesticides that are harmful to the environment and to a bioenvironmental balance [3].

Fig 2: Insect infected with fungus

Coporphilous Fungi: Animal dung and human faeces are food for many fungi because they contain many nutrients that have not been digested or absorbed in the gut, and they contain nitrogenous substances necessary for the growth of many microorganisms, they also contain the remains of decomposing blood cells, bile pigments and decomposing gut walls, and these substances provide microorganisms with many of their growth factors [3].

And by studying the fungi that appear on dung, it was found that there is an orderly sequence of the appearance of these fungi on dung. (Ascomycota) Finally, the Basidiomycota fungi appear, and this fungal sequence on the dung shows the divine appreciation in creation, and that there is no place for chance and randomness. In the beginning, dung contains sugars, (hemicellulose) and nitrogen, and this activates the presence of members of the order mucorales of the zygomycota.

Then cellulose predominates, and this leads to the emergence of Ascomycota, and in the end the lignin remains, and this leads to the growth of Basidiomycota.

Aquatic Fungi: Fungi are generally terrestrial micro-organisms, but there are aquatic species, and most of them follow the Oomycota and are found in fresh, salty and mixed waters, and most of them live on the eggs, bodies and embryos of marine organisms and cause diseases for many of these organisms.

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