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Participation of Algae in Soil Processes

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Abstract: *This article presents information about the participation of algae in soil processes. Soil algae are involved in the processes of soil formation, accumulating soil organic matter, enriching it with nitrogen, providing an anti-erosion effect and participating in biological land reclamation.*

Keywords: *Microcoleus vaginatus, biomass of green, yellow-green algae, cyanobacteria, phototroph, taxonomic, Nostoc muscorum.*

Formation of organic matter and nitrogen in the soil by algae. The total value of the biomass of algae is small (0.5-1 t/ha). However, annual production exceeds biomass (Table 2). Due to its dynamism, algae biomass has a particular impact on soil life. Algae, as producers of biogeocenosis, enhance the biological activity of the soil. This leads to the mobilization of the nutrients of the soil itself. When the soil is inoculated with algae, the content of available phosphorus in it increases. Extracellular products of algae and mucous membranes are chelating agents that affect the physical and chemical properties of the soil.

The first information about algae in the soil appeared at the end of the 19th century. In 1907, an article by F. Frich was published on the participation of algae in soil processes. A systematic study of algae in the territory of the former USSR was started by M. M. Gollerbach in the 1930s. Since then, many analytical articles and monographs have been published. [Gollerbakh M.M. 1936-1953; Zaer 1956; E. A. Shtina 1959; N. N. Bolshev 1968; M. M. Gollerbakh, E. A. Shtina 1969; K. Yu. Musaev 1960; Sh. Zh. Tojiboev 1973; E. A. Shtina, M. M. Gollerbakh 1976; L. N. Novichkova, Ivonova 1980; T. I. Aleksakhina, E. A. Shtina 1984; Getsen 1985; Kabirov R.R. 1991; Dubovik I.E., 1998; S. T. Mamasoliev 2019; Yu. A. Tukhataboeva 2019; O. Khusanova 2019].

Algae are involved in the formation of soils where plants do not develop as biological agents of phytotrophic organisms [Davey and Rothbery 1993; Patava, 1998]. There is a lot of information about the importance of algae in the barren soils of our Central Asia [Bolshev N.N., 1968, Novichkova L.N., Ivonova, 1980].

Algae are even more important in well-formed soils. These organisms, which can only be seen under a microscope, produce a large amount of organic matter due to phototrophy [EA Shtina, MM Gollerbakh, 1976]. In the absence of macroscopic outgrowths, they reach up to 1 t/ha [EA Shtina, 1977]. Due to the development of algae on the soil surface, the soil surface becomes “green”, and an increase in this indicator by 10 times [Kooken 1974] and even 15 times [Fuller, Rogers 1952] per 1 ha has been established. According to S. N. Dedish, the biomass of green and yellow-green algae, which cause the "blue" of the soil, is up to 70-90% of the total microbial mass. The share of algae in the formation of soil organic mass is determined by its productivity. According to their data, the productivity of algae per month is 266.6 kg/ha [Kabirov R.R. 1978].

Most cyanobacteria convert atmospheric molecular nitrogen into a bound form. The amount of nitrogen bound by algae in the soils of the former USSR reached 0.5 million tons per year (Mishustin and Pankratova, 1974). Nitrogen-assimilating cyanobacteria in the soil activate processes in it, and the organic matter accumulated by them increases soil fertility (Mezenaeva, 1982). For this reason, there are proposals to place them in the soil [Umarova 1983, Pankratova 1994].

Algae in soils are resistant to extreme conditions. They appear as the first phototrophs in sediments that brought water after precipitation [MM Gollerbakh, EA Shtina, 1976, Gorte, 1992]. In some areas of the arid region and in places where the soil surface warms up to 60-70 ° C, they retain their viability [M. M. Gollerbach, 1976].

At the same time, a number of biological aspects were taken into account, such as the ubiquitous distribution of algae, resistance to adverse extreme conditions, and the rate of reproduction. V. N. Vernadsky called it "The flow of living matter on the surface of the earth." Along with other organisms, algae provide the earth's ecosystem, its stability at the level of the organism's population [Dubovik I.E., 1998; Mamasoliev S.T. 2019].

The conditions mentioned above are important and valuable for the processes occurring in the soil in nature and as a result of anthropogenic impact, since the habitat of endobionts is gradually deteriorating. At present, steps have been taken for the taxonomic study of algae, which are a phototrophic part of the soils of our republic. In this regard, preliminary studies were started [Musaev K.Ya., 1960; Sh. Zh. Tojiboev 1973]. Suggestions for the role of algae in soil erosion control date back to the former Soviet Union.

[Gollerbakh M.M., Shtina E.A., 1969; Gael, E. A. Shtina, 1974; E. A. Shtina, M. M. Gollerbakh 1976; Morkova 1977; Dubovik I.E., 1998; Miniboy 1981; E. A. Shtina 1991; Dubovik I.E., 1998]. Algae produce mucus from their cells during their life cycle. This substance sticks together soil and sand particles, fibrous species give the soil mechanical strength. In 1997, West was the first to determine that soil particles are bound together by algae. species of Microcoleus vaginatus from cyanobacteria [Schwabe 1963; Markova, 1977], the commune of Nostok [Dragnov, 1977], species of the genus Plectonema proved the existence of such characters [Goel, E.A. Shtina, 1974]. It has been established that not only cyanobacteria, but also green algae are strengthened due to the sliming of their cell walls during the strengthening of sand particles in motion (Sharipova, 1977). In Chlorhormidium montanum, the length of its filamentous thallus reaches 13.3-38.0 m per 1 cm² of grains of sand [Goel, E.A. Shtina, 1974]. Single-celled cyanobacteria Synechococcus form a crust, trapping particles scattered in sand dunes, reducing erosion, increasing moisture and creating conditions for the development of other algae and fungi in the soil. Cyanobacteria actively develop in immobile eroded soils (Mareva, 1977). Microcoleus vaginatus increased productivity by surrounding volatile soil particles that did not produce grass, increasing the accumulation of organic matter and, as a result, increasing the amount of water and salts in the soil. 300 days after the introduction of the cyanobacterium Nostoc muscorum into soils with poor physical properties, the aggregate strength increased by 18%, carbon by 50%, nitrogen by 12-20% [Borgers, Burns 1994].

Microcoleus vaginatus developed in the soils of Colorado, USA, covered 70% of the soil surface, accounted for 95% of the soil biomass, and cyanobacteria retained moisture and improved the water regime [Garden 1993].

Soil algae are distinguished by a variety of feeding methods. At shallow depths, within the limits of light penetration, they are typical phototrophs, which, like higher plants, use low-intensity light for photosynthesis (0.04-0.1% of the total illumination). With depth, the abundance and diversity of algae decreases sharply. In addition to the direct influence of algae on the processes of soil erosion, they indirectly prevent the leaching of biological fertilizers from the soil. It also contributes to the enhancement of biological activity and the development of higher plants [E.A. Shtina, M.M. Gollerbakh, 1976].

Conclusion

Algae, which play an important role in soil processes, participate as a component of the biosphere. Therefore, we consider the study of the relationship between soil erosion processes to be one of the important aspects. Information about the development of algae in eroded soils can be used to prevent, control and implement conservation measures against modern erosion.

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