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Winter Analysis of Algoflora of Erosed Soils of Fergana Valley

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ASTRACT

Today, in the world it payed a great attention to ensuring soil stability, assessing the ecological and sanitary condition of eroded soils and substantiating the role of soil microflora in the classification of eroded soils into different types. Accordingly, the substantiation and implementation of the laws of formation of algoflora in soils under the influence of anthropogenic factors is a topical issue. In this regard, it is important to assess the current state of algae, especially in eroded soils, inventory, identify specific species, isolate their strains, obtain biomass.

Winter analysis of algae flora of eroded soils of the Fergana Valley revealed the occurrence and predominance of species belonging mainly to the Cyanophyta and Chlorophyta divisions, with a small number of species belonging to the Bacillariophyta division. The obtained species were studied on the basis of microscopic analyzes in samples taken from the soil layers of the surface layers and profile of eroded soils.

KEYWORDS: Fergana, algoflora, erosion, profile, horizon, layer, Cyanophyta, Shlorophyta, distribution area, leading species.

INTRODUCTION

The Fergana Valley is bounded on the northwest by the Mogultog and Qurama mountain ranges, on the north by the Chatkal ridge, on the east by the Fergana ridge, and on the south by the Alay and Turkestan ridges.

At altitudes of up to 400 meters in the Fergana Valley, mainly meadow, meadow-swamp, saline saline soils of different levels are widespread. At altitudes of 400 to 800 meters in the study area, mainly gray and light brown soils are common. At the altitudes of 800-1200 meters in the Fergana Valley, mainly light gray soils, dark and typical gray soils are distributed. They contain up to 4 percent humus.

Anthropogenic and natural-anthropogenic landscapes are emerging instead of the original natural landscapes, as a result of which the foothill landscapes of the Fergana Valley have been used under human influence for many years. In particular, the misuse and misappropriation of foothill landscapes is leading to a disturbance of the natural balance. This leads to the development of natural and anthropogenic processes in landscapes, such as salinization, water erosion, erosion, landslides, suffocation. In addition, the biotic composition of the settlement is changing as a result of wind and water erosion under the influence of abiotic factors in the soils of the valleys, mountains and foothills of the valley, where human activity is not involved. This leads to a change in the species composition of algae flora, which develops in these soils.

Soil erosion (lat. Erasio erosion, erosion) - the process of erosion of the most fertile topsoil and subsoil under the influence of atmospheric precipitation and irrigation water, wind, etc. According to the degree of occurrence, it is divided into natural and accelerated (erosive) species. Natural soil erosion is relatively slow and the soil is regenerated during the natural formation process. Soil erosion begins mainly in areas where the relief is uneven - low, some of the erosion (the difference between the height above sea level in m of a particular place and the height above sea level of the land from which the water flows) is large. Soil erosion is divided into such types as water, wind, industrial, abrasion, pasture, mechanical soil erosion according to the factors of formation [Mukhamedov T., 1973].

Algae play a major role in soil formation. In this case, mainly microscopic organisms produce large amounts of organic matter [Gollebax, 1969; Shtina, Gollerbax, 1976].

In addition to the direct effect of algae on the erosion process, an indirect effect has also been identified - i.e., an indirect effect that strengthens the biological fertilizers in the fields from leaching [Shtina, Gollerbach, 1976].

Small single-celled algae trap soil particles by separating mucus from themselves. *Synechococcus* *guardians* (Nageli, 1849) were the first to be found in sand substrates, forming crusts and reducing erosion. This process promotes good infiltration of water and good placement of algae, bacteria, fungi and plant seeds in the soil [Ch.I.Potsene, 1976].

G.I. Markova (1976, 1977) noted the presence of ipsimon blue-green algae in the streamless eroded slopes.

The algae that live in the sands stick the sand particles together, improving the condition of soils with a normal structure, accumulating organic matter. Algae found in cliff erosion reduce erosion, maintaining lateral and longitudinal erosion of cliffs [Kostikov, 1989].

In dark gray soils at an altitude of 1300 m above sea level, the cyanophyta division of the family *Oscillatoriceae* is characterized by a large number of species. Heterocystic from the Cyanophyta division, soils of the Nostocales order, which can assimilate molecular nitrogen in the soil atmosphere, and taxa of the Xanthophyta subdivision are widely distributed in soils of the mountain region at 2000 m and above [K.Yu.Musaev, 1965, V.P. But, 1963].

I.E. Dubovik conducted research on the algae flora of eroded soils and measures for their protection in the territory of Bashkortostan. In his research, he studied the types of erosion in the soils of the territory of Bashkortostan, namely: wind erosion, water erosion, cliff erosion, elevation erosion, and the algoflora of these eroded soils [I.E. Dubovik, 1998].

In addition, soil algae flora has been studied by several researchers in the CIS countries: I.V.Raxmatullina [2008], L.M.Safiullina [2009], E.S.Purina [2009], T.R.Kabirov [2009], N.P.Aksenova [2010], A.G.Blagodatnova [2010], A.B.Yakupova [2012], M.P.Lebedova [2012], Yu.M.Bachura [2013], Yu.N.Zykova [2013], E.S.Solovyova [2015], E.A.Gornostaeva [2015], L.N.Novichkova-Ivanova [2017].

There are few studies on the composition of soil algoflora in the country, the main research is conducted by Sh.U.Umarova [1959], K.Yu.Musaev [1965], U.N.Toshmukhammedov [1971], E.K.Troitskaya [1961], Sh.Tojiboev [1973], O.Xusanova (2019), S.T. Mamasoliev [2019], Yu.A. Tukhtaboeva [2019].

MATERIALS AND METHODS

Samples for the study were taken from the eroded soils of the Fergana Valley. The sampled areas are from the eroded hills in the Yaypan, Shorsuv and Chimgan areas of the Fergana region; From the hills of Arbagish and Alihon villages of Namangan region; Taken from the soils of the Olamushuk hills of Andijan region, the coordinates of the sampled areas and altitudes above sea level are given in Table 1. The “method of collection and processing of materials generally accepted in soil algology” was used in the collection and study of soil-algal samples [4].

Vegetation, land area, and soil characteristics of the site selected for collecting soil algae samples from the study area were studied, and areas of special importance were identified as sampling points. Simultaneously with the collection of soil samples, the general appearance of the soil surface, humidity, air humidity, mechanical composition of the soil, the index of hydrogen ions (pH) were taken into account as important factors for the study of seasonal dynamics of algae [4].

Soil samples were taken from the prepared surface section (0–2, 3 cm) for “cutting”. Samples were taken from a sample area of 10–50 cm2. Samples were collected in pre-sterilized special packages according to genetic horizons and profile. Sampling began from the lower horizon. Soil-algal samples were also taken from under the snow as the samples were taken during the winter.

Table 1. Areas sampled from eroded soils of the Fergana Valley

Soil samples from the fields of South Olamushuk, Andijan region (3.02.2022)														
Sample numbers	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Region coordinates	40° 44,35 N 72° 33,57 E	40° 44,37 N 72° 33,55 E	40° 44,37 N 72° 33,56 E	40° 44,35 N 72° 33,56 E	40° 44,34 N 72° 33,54 E	40° 44,39 N 72° 33,56 E	40°44,45 N 72° 33,53 E	40° 44,49 N 72° 33,53 E	40° 44,50 N 72° 33,56 E	40°44,50 N 72° 33,57 E	40° 44,52 N 72° 33,58 E	40° 44,50 N 72° 33,58 E	40° 44,46 N 72° 34,01 E	40°44,29 N 72° 33,59 E
Elevation above sea level (m)	712	727	721	713	710	731	741	752	754	760	767	758	746	690
Yaypan Shursuv massif of Fergana region (4.02.2022)														
Sample numbers	1	2	3	4	5	6	7	8	9					
region coordinates	40°17,52 N 70° 46,53 E	40°18,34 N 70°46,53 E	40°14,51 N 70°49,22 E	40°14,59 N 70°48,31 E	40°14,52 N 70° 49,20 E	40°14,53 N 70° 49,16 E	40°14,51 N 70°49,31 E	40°14,47 N 70°49,35 E	40° 14,48 N 70°49,31 E					
Elevation above sea level (m)	640	642	675	682	674	679	675	687	681					
Chartak-Arbagish hills of Namangan region														
Sample numbers	1CH	2CH	3CH	1Ar	2Ar	3Ar	4Ar							
region coordinates	41°10,22 N 71°49,26 E	41°10,21 N 71° 49,30 E	41°10,19 N 71° 49,36 E	41°16,11 N 71° 50,51 E	41°16,03 N 71° 50,56 E	41° 16,04 N 71° 50,58 E	41° 16,02 N 71° 51,00 E							
Elevation above sea level (m)	735	737	745	720	730	725	718							

The samples were dried. This does not affect the determination of the complete taxonomic composition of the algae in it.

In the study of soil-algal samples were used the method of "Cup culture" and various modified nutrient media [Bristol, 1920; Lund, 1945, 1947; Kostikov 2001; Gollerbax, Shtina, 1969; Kuzyaxmetov, Dubovik, 2001]. To prepare the cup culture sample, 20-40 g of air-dried and well-mixed soil was first placed in a Petri dish. Soil samples were moistened to 60-80% with distilled water and liquid nutrient medium - Bristol. On each wetted sample, 3-5 cover windows were closed. The purpose of this is to cover the glass with a moisture content of 40-60%. Samples in Petri dishes were then placed in a well-lit place for storage for 1-2 weeks [2]. A few weeks later, a sample of the green coatings formed on the surface of the Petri dishes (Fig. 1) was observed under a N-300M (c UCMOS09000KPB9.0M) microscope and the taxonomic composition of the species was studied.

In order to more accurately cultivate and identify the species in the samples, soil-algal samples were planted in special containers using the "Liquid Culture Method", ie 1-2 g of soil was added, 80-90 ml of Bristol [Bristol, 1920] was poured on top and the mouth was covered with paraffin. (Figure 2). They were also placed in a well-lit room.

Figure 1. Soil samples planted in petri dishes and the development of algae in them

RESULTS OBTAINED AND THEIR ANALYSIS

Due to the fact that the samples were taken in the winter and the low temperature, the vegetation period of the soil algae started a little later than usual. The development of 49 soil-algal samples taken from the designated areas and planted in Petri dishes also started after 2-3 weeks. A green layer was found in a soil sample taken from the hills of Chartak district, and when observed under a microscope, it was found to contain green algae *Gomontia perforans* (Chodat, 1916) (Fig. 2). Such layers were also observed in the remaining samples, and each was detected under a separate microscope. In each of the soil samples taken from the hills of Fergana, Andijan and Namangan regions, it was found that a separate algae colony was formed. The color of the colonies was mainly blue-green, and it was seen that the algae attached the soil particles to the cell surface due to the release of a slimy substance, and that the color of the colony turned slightly brown.

Samples taken from the eroded soils of the Fergana region revealed a high prevalence of species belonging to the blue-green Cyanophyta division. They are: *Microcystis muscicola* (Menegh), *Microcystis pulverea f.racemiformis* (Nygaard), *Anathece clathrata* ((West & G.S.West) Komárek, Kastovsky & Jezberova), *Borzinema rupicola* (Borzi) G.D.Toni), *Gleocapsa alpine* (Nageli), *Gleocapsa compacta* (Kutz,1843), *Gleocapsopsis dvorakii* ((Novacek) Komarek &Anagnostidis ex Komarek), *Aphanocapsa paretina* (Nageli), *Microcystis aeruginosa* (Kutzing) [3]. The cells of the species identified from the N-1.F.Sh. sample are arranged in a ball, in the form of long needles, arranged in a star. Again in this sample there were identified algae, which formed an irregularly shaped colony. Covered with a mucous shell, the cells inside the colony are spherical, light green in color. N-5, N-10 F.Shю samples were found to have similar cells.

Another type of cell in the N-5. F.Sh. sample was the leaf-*shaped Cymbella Bergii f. Baicalensis* (Skvortsov & Meyer 1923) species, which was thinned at both ends, had a flat chromatophore along the edge of the cell, and had black spots on both ends.

Samples from Andijan region also revealed the composition of species belonging to the genus Cyanophyta, as well as species belonging to the genus Bacillariophyta and Euglenopyta. [3,5,8,9].

The cells of the species belonging to the Euglenopyta division identified in the N-1. An sample are very small, light green, leaf-shaped, and have a clearly visible chromatophore in the cell, which are: *Trachelomonas oblonga*, *Trachelomonas oblonga f.minor* (Taskin & Alp, 2019). Species belonging to the same category were also identified in the N-14.An. sample. Its cells are thin on both sides, the shape is dull, with a thin thread on one side of the body. Chromatophores are scattered throughout the body [1, 9].

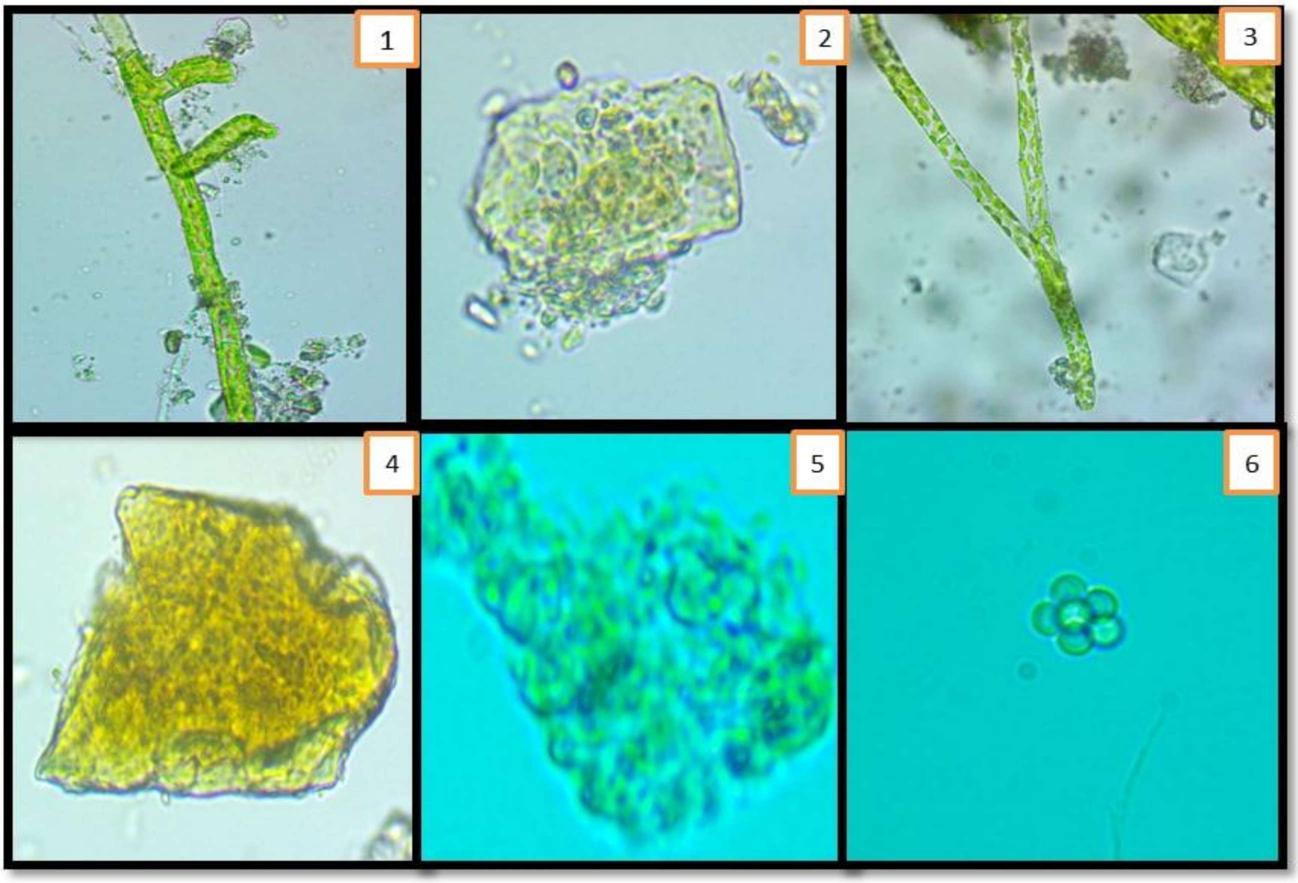

Figure 2. 1-*Scytonema crustaceum var.incrustans*; 2-*Aphanocapsa parietina koloniyasi*; 3-*Scytonema crustaceum; 4*-adhesion of soil particles to the surface of the *Aphanocapsa conferta* colony*; 5-Gleocapsa compacta; 6-Gleocapsa alpina.*

In the sample N-14.An., the species *Pinnularia accuminata (*Smith, 1853*)*, and *Nitzschia lancelata var.minor* (Husted) belonging to the division Bacillariophyta were also identified. One of them is leaf-shaped, with a series of chromatophores on the outer edges of the cells, and ribs on both sides of the cell. The cell of the second identified tourniquet is duximon-shaped, slightly tapered at both ends, with a rounded front and rounded markings. In the middle of the body there is a series of round ribbon-shaped marks [1, 8].

In samples N-4.An., N-5.An., N-6.An., N-10.An,. N-14.An the species *Hapalosiphon fontinalis* (Bornet, 1889), *Microcystis endophytica* (Smith, 1938), *Aphanocapsa paretina* (Nageli), *Microcystis pulverea f.racemiformis* (Nygaard) and *Chroococcus minor* ((Kutzing) Nageli) belonging to the genus Cyanophyta have been identified. Its cell is fibrously branched, branched in certain places, the branches are not divided into joints, there is no barrier between the cells. Inside the trichome are large, distinctive leaf-like chromatophores arranged in an orderly fashion. The types of algoflora identified from each region were represented in diagrams and tables (Figure 3).

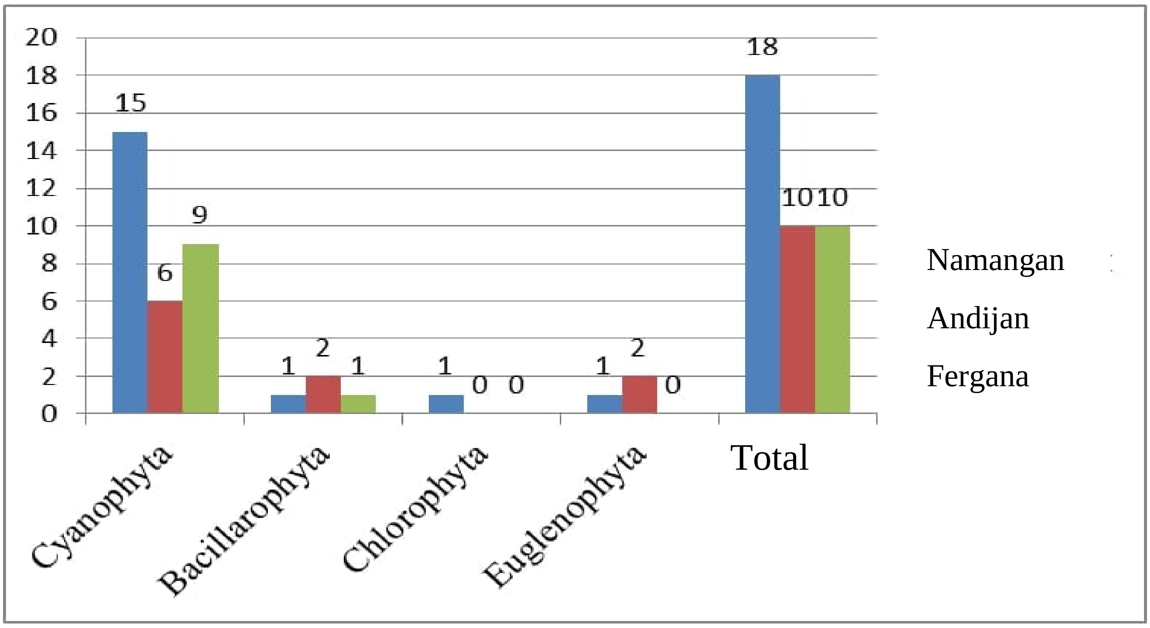

Figure 3. Formation of algoflora in eroded typical gray soils

The second identified is *Aphanocapsa paretina* (in the structure of Nageli algae, the cells are small cocoid in shape and light green in color. Around the small cells, a type with a fibrous structure, the body of which is not divided into fragments, has been identified [3].

Algae species belonging to the Chlorophyta, Cyanophyta and Euglenopyta divisions were identified in the samples taken from the hills of Chartak district and Arbagish village of Namangan region. Among the identified species, the largest number was found to belong to the Cyanophyta division [3, 5, 9].

The cell type of the algae identified in the N-1.Ch. sample was fibrous, branched, but did not form a articulated branch. It does not have a separate cell separation. In green, the type of Gomontia perforans (Chodat, 1916) with chromatophores located in the same plane was identified [Opr.-10. Zelen. Moshkova N.A., Gollerbax M.M., 1986].

The cells of the species Trachelomonas oblonga, *Trachelomonas oblonga f.minor* (Taskin & Alp, 2019) belonging to the division Euglenopyta identified in the sample are very small, light green, leaf-shaped, with a clearly visible chromatophore in the cell.

In N-1.Ch., N-2.Ch., N-5.Ch., N-3.Ch., N-6.Ch., N-7.Ch., N-1.Ar., N-2.Ar. samples, aquatic species belonging to the Cyanophyta division were identified. All species belonging to this category differ from each other by their morphological form. Species occur in both individual cell form and colony form. Each identified species has its own definition. Among the species belonging to the cyanophyta division, the representatives were mainly of cocoid structure. The shape of the colony has an uneven structure.

Table 1. Taxonomic structure of Cyanophyta division determined from eroded soil.

Class	Procedure	Family	Category and type
Cyanophyceae	Chlorococcales	Microcystaceae	Microcystis endophytica
			Microcystis aureginosa
			Micocystis marginata
			Microcystis pulverea f.racemiformis
			Microcystis flos-aquae
			Microcystis protocystis
			Aphanocapsa. conferta
			Aphanocapsa muscicola
			Aphanocapsa parietina
			Gleocapsa alpine
			Gleocapsa minor
			Gleocapsa compacta
			Gleocapsopsis dvorakii

	Nostocales	Hapalosiphonaceae	Hapalosiphon fontinalis
		Scytonemataceae	Scytonema crustaceum Scytonema crustaceum var. incurstans
		Aphanothecaceae	Aphanothece saxicola Aphanothece conferta Anathece clathrata
		Borzinemataceae	Borzinema rupicola
	Synechocoocales	Romeriaceae	Romeria chlorina
Chlorophyceae	Ulothrichales	Gomontiaceae	Gomontia perforans
Euglenophyceae	Euglenidales	Euglenidaceae	Trachilomonas oblonga Lemmerman Trachilomonas oblonga var.minor
Bacillariophyceae	Naviculales	Pinnulariaceae	Pinnularia accuminata Cymbella Bergii f.baicalensis Nitzschia lancelata var.minor Nitzschia tibetana
4	6	9	28

Romeria chlorina (Bocher, 1949), a fibrous, unbranched, fibrous structure with uniform distribution of chromatophores in the same plane, *Scytonema crustaceum f.incrustans* (Kutzing) with a branched structure; the species *Microcystis aeruginosa* (Kutzing), *Microcystis marginata* ((Meneghini) Kutzing), *Microcystis pulverea f.racemiformis* ((Nygaard) Hollerbach), *Microcystis flos-aquae* ((Wittrock) Kirchner), *Microcystis protocystis* (Westing) (Kutzing), (S.West) Komarkoav-Legnerova & Cronberg), *Aphanocapsa paretina* (Nageli), *Aphanotece saxicola* (Nageli, 1849), *Scytonema crustaceum* ((Bornet & Flahault, 1889), *Scytonema f.incrustans* ((Kutzing), Diplonema rupola), *Romeria chlorina* (Bocher, 1949), *Chroococcus minor* ((Kutzing) Nageli) were identified in the form of a colony. This adheres to the soil particles due to the presence of a slimy substance in the shell of the identified species and protects the soil particles from erosion.

Among the identified species in the winter season, the species belonging to the Cyanophyta division led the way, and the taxonomic composition of all identified species and the number of individual species in each region were given in Table 1.

CONCLUSION

The cold temperature in winter has an effect on the development of soil algae. But there are algae species that continue their growing season even at such low temperatures. A total of 49 samples were taken from the designated areas during the winter season, and the taxonomic composition of the soil algoflora was determined. Each soil sample was planted using traditional methods and algae species were identified from the resulting green cover. The identified species mainly belong to the subdivisions Cyanophyta, Chlorophyta, Bacillariophyta, Euglenophyta. Among the identified species, the species belonging to the Cyanophyta division formed the most part and led the way. This section separates the slimy substance on the surface of the cell of the species representatives and is of particular importance with the property of sticking the soil particles and protecting the soil from erosion. The number of algoflora species was found to be lower in winter than in summer, spring and autumn, which is explained by the low temperature and the effect of algoflora on the growing season.

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