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Peculiarities of Distribution of Oligokarbophilic and Humus Mineralizing Microorganisms in Alkali Soils of Georgia

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ABSTRACT. The peculiarities of distribution of oligocarbophilic and humus mineralizing microorganisms in alkali soils of Georgia have been studied. Salinity and other physico-chemical indices of alkali soils were found to influence the quantity and qualitative diversity of microorganisms and the intensity of humification. *© 2010 Bull. Georg. Natl. Acad. Sci.*

***Key words**: alkali soil, mineralization of humus, oligocarbophilic microorganisms.*

Decay of the majority of plant and animal remains takes place in the soil. Easily mineralized material is subjected to rapid and complete oxidation, while compounds, resistant to degradation, stay in the soil for a long time and become its organic components.

Organic substances of the soil partially consist of imperfectly decayed plant material and partially – of humus. Humus is amorphous material of biological origin. Its content complicates the mineralization of compounds like lignin, fats, polysaccharides, etc. by the microorganisms.

Besides bacteria and fungi, protozoa and flat worms take part in humus formation [1, 2]. They bind mineral nitrogen and play an important role in soil fertility and structuring. The humus is in the state of dynamic equilibrium: on the one hand, its quantity increases at the expense of organic compounds, and on the other, it decreases as a result of biodegradation. The more is the content of humus in the soil the more indices of the soil assist in its formation, and conversely. The quantity of accumulated humus depends not only on climatic and soil conditions, but also on the nature of plant material [3].

Oligocarbophilic microorganisms take part in humus and resistant plant material degradation. They assist in forming a dynamic balance of humus quantity and represent one of the significant links in soil formation process.

Accordingly, the goal of our investigation was to study the intensity of the humification process in salty soils, its effectiveness and the qualitative and quantitative content of microorganisms, which to a considerable extent determine the fertility of such extreme soils; also to establish plant-cover variability and compactness.

Materials and methods. Alkali soil of sulfate type is met on the adjoining territory of Lake Kumisi, with sodium sulfate prevalence.

Five samples of salty soils were taken for investigation. Three of the samples (N1, N2, N3) were picked from the lake, directly from the zone of flow on the west and north-west coasts at distances of 5 (N1), 30 (N2) and 60 m, while two of them (N4 and N5) – on the south (N4) and north (N5) slopes of the hill, situated on the north-east coast of the lake. The samples were taken on June 8, 2008 under the following weather conditions: variable nebulosity, east wind – 3 m/sec, atmospheric pressure – 722-723 mm/, temperature – 15-27^{0}C and humidity – 64%.

Humidity of samples was determined gravimetrically in % [4].

Soil suspension was prepared according to a method known in microbiological practice [4].

Isolation of oligocarbophilic microorganisms and participation in humus mineralization was accomplished on Winogradsky nutrient medium [4]. for microorganisms of second phase of nitrification.

Identification of microorganisms was carried out according to [5].

The quantity of microorganisms was calculated per 100 g of absolutely dry soil.

Results and discussion. Analysis of data on quantity of moisture in soil shows that the index was different in samples and depended on the distance from the lake (Fig.1).

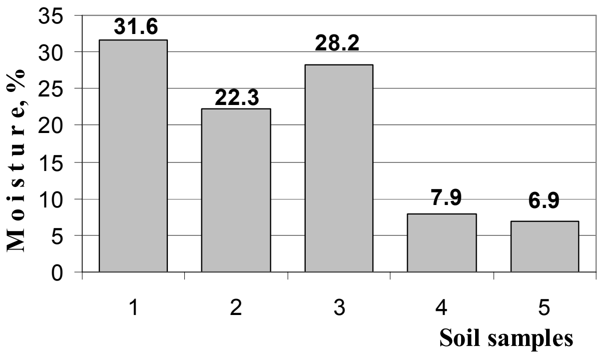

Fig. 1. Content of moisture in the soil samples

For example, in soil samples of the flow zone the content of moisture was high enough. At the same time the tendency was clear - the further was the point of samples taking from the lake, the less was the amount of moisture in it. sample 3 was an exception, in which the amount of moisture was higher than in sample 2. This may be explained by the fact that on the territory where the sample was taken water leaks from the channel adjoining the lake.

In samples taken on the slopes of the hill adjoining the lake, the amount of moisture was the lowest. This is easy to explain according to laws of physics: atmospheric precipitation quickly flows down to the lowest points of the territory, i.e. the lake.

Soil salinity depends not only on the amount of moisture occurring in it, but also on moisture shift and its direction.

There are many factors responsible for soil salinity: alkalization of soil, intensive water evaporation, content of salts, changing in depth and determining the profile of alkali soils. This factor is influenced by climatic conditions too: temperature, humidity and seasonality. Salinity reaches its maximum in summer and dry period of autumn when the amount of rainfall is low and a strong evaporation of water takes place. In snowy and rainy conditions soluble salts are dissolved in the water and are moved into the lower layers. Anthropogenic factors are very important. The invasion of man considerably changes the properties of alkali soils, particularly in cases when one talks about artificial alkalization.

Analysis of the salinity of soil samples shows that samples differed in salinity, which is connected with the amount of moisture (Fig. 2).

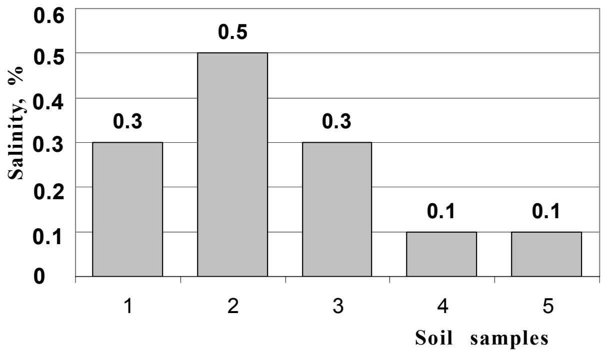

Fig. 2. The salinity of soil samples.

Particularly, soil in the zone of the lake flow was very salty as a result of water evaporation arising from the bottom of the lake to upper layers of the soil. At the same time, a layer of dry salt was formed on the surface of a thin, a few millimeter thick soil. With the distance from the flow zone salinity of the samples taken decreased. Sample 3 was again an exception, as the territory of its taking was fed by the channel water. Results obtained for samples taken from the hill adjoining the lake are absolutely different. Their salinity was the lowest, which may be explained by washing off with precipitation.

The quantitative analysis of oligocarbophilic and humus mineralizing microorganisms in soil samples has shown that all these microorganisms were represented in a sufficient amount, especially in the lake flow zone (Fig. 3).

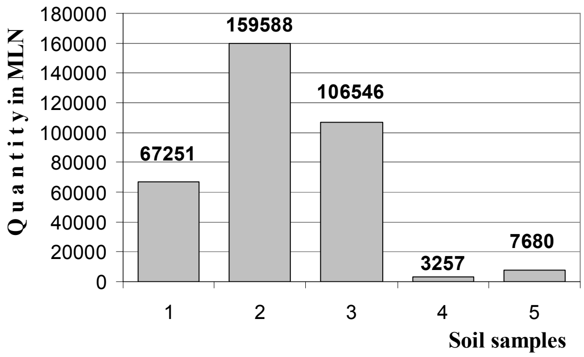

Fig. 3. Content of oligocarbophilic microorganisms in soil samples adjoining Lake Kumisi

Table

Qualitative content of oligocarbophilic and humus mineralizing microorganisms in samples of salty soils

Number of soil sample	Qualitative content of microorganisms	
	Mycobacterium	*Nocardia*
1	+	-
2	+	-
3	+	-
4	+	+
5	+	-

It is quite natural, as with the flows in these places salt is precipitated in a great amount, which is rich in organic compounds too. In summer period the lake returns to its usual location, while the crystallization of silt, left on the coast, continues. It must be noted that the greatest quantity of oligocarbophilic flora was registered in sample 2, which differs from other samples by relatively high salinity and low humidity. It is clear that relatively high salinity does not appear to be a restricting factor for humus mineralization, as low humidity promotes structuring and aeration of the soil and this is positively reflected on the quantity of oligocarbophilc microorganisms.

The quantity of oligocarbophilic microorganisms was very low in soil samples taken on the slopes of hill; Though in the sample from the north slope of hill this index was almost two times higher than in the samples of south slopes. This may be connected with the scarcity of plant cover on the latter and, correspondingly, to less quantity of dead plants.

The general scarcity of oligocarbophils on the north slope adjoining Lake Kumisi is presumably connected with the minimal humidity of the soil.

Fig. 4. The representatives of *Mycobacterium* family spread in samples of soil.

Analysis of the quality of oligocarbophilic and humus mineralizing microorganisms in soil samples shows (Table) that this index is similar for different samples and mainly is represented by the representatives of *Mycobacterium* family (Fig 4); Though some representatives of *Nocardia* family were also evidenced in soil sample from the south slope of hill adjoining the lake.

The representatives of *Mycobacterium* family found in soil samples were characterized by weak halophillic properties, quick growth on a simple nutritious medium, and were saprophytes.

Thus, some alkali soils of Georgia are not distinguished for quantitative abundance and qualitative diversity of oligocarbophilic and humus mineralizing microorganisms, which may be explained by the physical and chemical peculiarities of alkali soils, their salinity level and scarcity of vegetable plant cover, which for its part affects the intensity of humification.

მიკრობიოლოგია და ვირუსოლოგია

საქართველოს მლაშობ ნიადაგებში ოლიგოკარბოფილებისა და ჰუმუსის მინერალიზაციაში მონაწილე მიკროორგანიზმების გავრცელების თავისებურებანი

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(წარმოდგენილია აკადემიკოს გ.კვესიტაძის მიერ)

შესწავლილია საქართველოს მლაშე ნიადაგებში ოლიგოკარბოფილებისა და ჰუმუსის მინერალიზაციაში მონაწილე მიკროორგანიზმების გავრცელების თავისებურებები. დადგენილია, რომ მლაშობი ნიადაგების მარილიანობა და სხვა ფიზიკურ-ქიმიური მაჩვენებლები გავლენას ახდენს ამ მიკროორგანიზმების რაოდენობაზე, თვისებრივ მრავალფეროვნებაზე და მათ მიერ წარმოებული ჰუმიფიკაციის პროცესიის ინტენსივობაზე.

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