საქართველოს მეცნიერებათა ეროვნული აკადემიის მოამბე, ტ. 3, №1, 2009
BULLETIN OF THE GEORGIAN NATIONAL ACADEMY OF SCIENCES, vol. 3, no. 1, 2009

Microbiology

Study of Nitrogen Fixatives in Acid-Black Earth Soils of Upper Abkhazia

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ABSTRACT. The peculiarities of distribution of nitrogen fixative microorganisms in acid-black earth soils of Zemo Abkhazeti have been studied. On the basis of data obtained it has been established that acid-black earth soils of Zemo Abkhazeti are rich in both aerobic and anaerobic flora which has the ability for atmospheric nitrogen fixation. The research soil samples considerably differ in qualitative and quantitative content of nitrogen fixatives, conditioned by different climatic-geographic features of these places. *© 2009 Bull. Georg. Natl. Acad. Sci.*

Key words: *acid-black earth soil, nitrogen fixative microorganisms, aerobic and anaerobic flora*

Eukaryotic and prokaryotic organisms are found in the soil and a complex interdependency is established between them, the stability and dynamics of which conditions the physical-chemical parameters of the soil. The latter along with abiotic and biotic factors ensure the stability and originality of the biocenosis and agrocenosis. So, soil appears to be not only a living environment of different organisms but also a product of their vital functions.

Soils are permanently subject to the influence of abiotic, biotic and anthropogenic factors which finally change the stability and originality of bio- or agrocenosis related to the soil. Therefore with the aim of prevention a timely study of processes occurring in the dynamics in the soil allows to make prognosis of undesirable phenomena and to stimulate the desirable shifts.

The best indicator of similar processes taking place in the soils is to study the microflora of the soil whose representatives instantly react to the changes and alter the soil themselves as their living environment and a product of vital functions[1,2]. Then these changes are reflected on other members of ecological co-society.

In this respect, it is especially important to determine specifically the microorganisms participating in the mobilization and assimilation of nitrogen in the soil and their qualitative and quantitative ratio in the cenosis, including the balance between them and the direction of the processes.

Proceeding from this, the goal of our work was to study the microflora of Zemo Abkhazeti acid-black earth soils, particularly the qualitative and quantitative content of free-living nitrogen fixatives.

Material and methods

The content of microflora of Zemo Abkhazeti acid-black earth soils was studied. Two samples were taken in the village Azhara (950 m a.s.l.) and Chkhalta (710 m a.s.l.).

Acid-black earth soils are characterized by weak acid or acid reactions, an average content of humus, an

equal redistribution of mineral oxides; it contains a great amount of potassium salts and is characterized by a young age of soil-formation, as well as by well expressed dead covering and differentiating profile. Soil moisture was determined in percentage according to the well-known method [3]. Soil suspension was prepared according to the method well known in microbiological practice [3].

Determination of free-living aerobic and anaerobic nitrogen fixative microorganisms was carried out according to the method of Vinogradski by isolation into soil lumps and special selected media.

Quantitative determination of microorganisms was carried out using Mc-Credy Tables [3].

Results and analysis

The content of moisture in the studied soils was determined. The amount of moisture in the samples of soil is given in Fig.1.

The analysis of results given in Fig. 1 shows that in both types of acid-black earth soils the amount of moisture is sufficiently small and varies between 1.8 and 4.1%. At the same time, in the sample of Azhara soil the amount of moisture is approximately 2.5 greater as compared to Chkhalta sample which is explained by a high location of this territory above the sea level and lower characteristics of average annual index of the temperature.

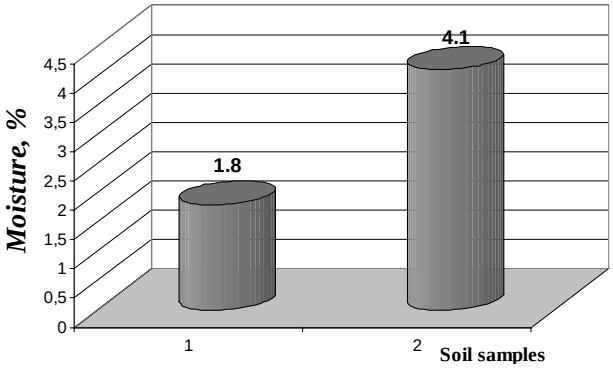

Fig. 1. Amount of moisture in samples of acid-black earth soils of Zemo Abkhazeti in %. 1 - Chkhalta, 2 - Azhara.

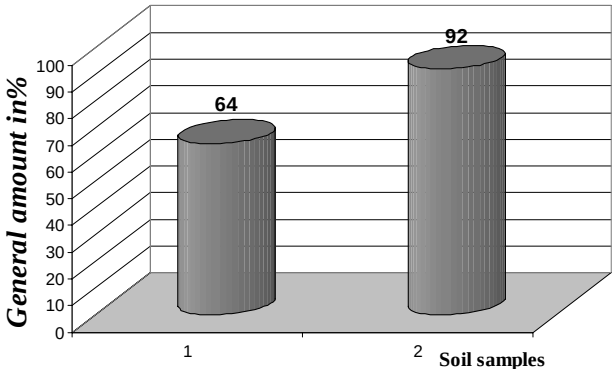

Fig. 2. General amount of aerobic nitrogen fixatives in acid-black earth soils of Zemo Abkhazeti in %. 1 - Chkhalta, 2 - Azhara.

Microorganisms having the ability of atmospheric nitrogen fixation play an important role in the supply of soils with biogenic nitrogen. Their quantitative index appears to be an important parameter of soil fertility. The quantitative content of aerobic nitrogen fixatives in acid-black earth soils of Zemo Abkhazeti is given in Fig.2.

The analysis of the results given in this scheme shows that acid-black earth soils of Zemo Abkhazeti are especially rich in free-living aerobic nitrogen fixative microorganisms. However, this index is higher (approximately by 1.5) in the sample of Azhara soil, which presumably is related to more favorable conditions due to a high moisture for the development of microorganisms in it. The quantitative content of anaerobic nitrogen fixatives in acid black earth soils of Zemo Abkhazeti is given in the Fig.3.

The analysis of the results given in Fig. 3 shows that in the samples taken from the soils of Azhara territory the amount of anaerobic nitrogen fixatives is 29 times greater as compared to Chkhalta sample. Presumably, this fact is also due to different indices of moisture and the environment created by them for its vital functioning, as in the case of different airing conditions an opposite result should be obtained. Particularly, if the relatively high moisture of Azhara acid-black earth soil is due to low airing and less structuring, then the amount of aerobic nitrogen fixatives should be low, while of anaerobic - high. An opposite phenomenon should take place in the Chkhalta soil sample.

Anaerobic nitrogen fixative microorganisms are mainly represented by three species of *Clostridium* family - *pasteurianum, butyricum* and *acetobutylicum*.

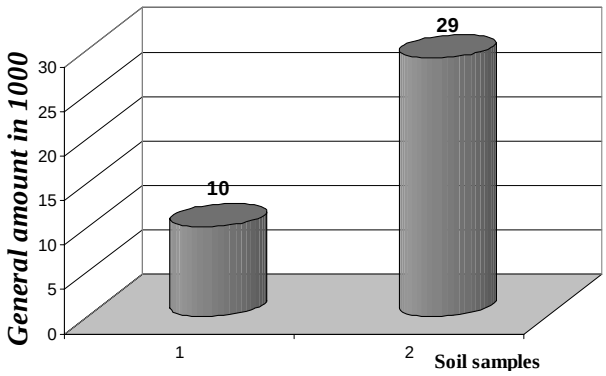

Fig. 3. General amount of anaerobic nitrogen fixatives in acid-black earth soils of Zemo Abkhazeti in 1000 of 1g of air-dried soil. 1 - Chkhalta, 2 - Azhara.

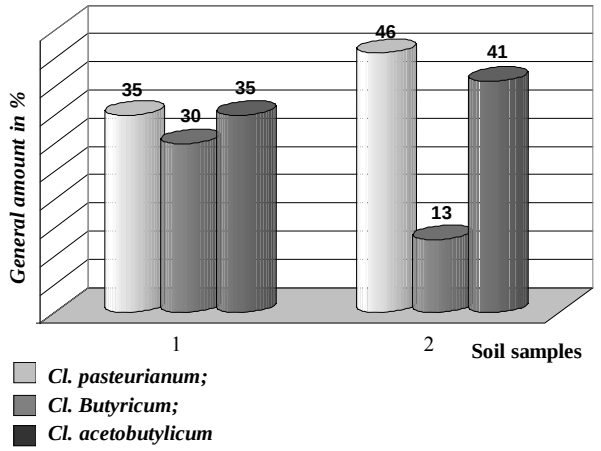

Fig. 4. Quantitative ratio of anaerobic nitrogen fixatives in the samples of acid-black earth soils of Zemo Abkhazeti in %. 1 - Chkhalta, 2 - Azhara.

The quantitative ratio of these three microorganisms in two samples of acid black earth soils of Zemo Abkhazeti is given in Fig.4.

The results given in Fig.4 prove that all the three species of anaerobic nitrogen fixatives of Chkhalta sample are presented almost equallys while in Azhara sample *Clostridium pasteurianum* and *Clostridium acetobutylicum* dominate.

The analysis carried out in our experiment has shown that the acid-black earth soils of Zemo Abkhazeti are sufficiently rich in microorganisms having the ability for atmospheric nitrogen fixation both with aerobic and anaerobic flora. Their qualitative-quantitative difference in the samples taken in different places is conditioned by the different climatic-geographic characteristics of these places.

მიკრობიოლოგია

ზემო აფხაზეთის მჟავე-ყომრალ ნიადაგებში აზოტფიქსატორების შესწავლა

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სტატიაში აღწერილია ზემო აფხაზეთის მჟავე-ყომრალ ნიადაგებში აზოტფიქსატორი მიკროორგანიზმების გავრცელების თავისებურებანი. მიღებული მონაცემების საფუძველზე დადგინდა, რომ ზემო აფხაზეთის მჟავე-ყომრალი ნიადაგები მდიდარია ატმოსფერული აზოტის ფიქსაციის უნარის მქონე როგორც აერობული, ისე ანაერობული ფლორით. ნიადაგის საკვლევი ნიმუშები მნიშვნელოვნად განსხვავდება ერთმანეთისაგან აზოტფიქსატორების თვისებრივი და რაოდენობრივი შედგენილობით, რაც განპირობებულია ამ ადგილების განსხვავებული კლიმატურ-გეოგრაფიული მახასიათებლებით.

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Received December, 2008