SEASONAL VARIATION OF AMMONIFIER BACTERIA IN HEAVY MELIORATED SOILS

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Abstract: In this article the results of the investigation of the activity of soil microorganisms in slightly saline and medium saline soils. In spring, when the humidity and temperature are optimal, the number of ammonifying bacteria is higher, while in summer, where there is a decrease in humidity, their number declines sharply. In autumn, the number of bacteria studied increases markedly with a decrease in temperature.

Key words: saline soils, low salinity, gypsum soils, medium salinity, biological activity, microorganisms.

Introduction.

Microorganisms are found everywhere in the natural environment. However, majority are known to live in the upper layers of the soil. Despite the fact that the average weight of bacteria in the soil is 7–9*10¹⁴ g, their biomass is estimated at 3–5 ton per hectare, the presence of 2–5 t microorganisms in the cultivated soil layer is well reported [7].

Bacteria are one of the most common types of microorganisms in the upper layer of soil. Their numerical quantity [8], during which in the recording time using a most probable counting method, is observed that their number in 1 gram of soil can reach in billions. The quantitative number of bacteria in the soil depends primarily on the soil type and its engagement in cropping system. Moreover, the number of bacteria in the soil varies along the depth of the soil layer and fluctuates throughout the season. In particular, the upper layers of the soil (up to 30 cm) contain a large number of bacteria, while the lower parts comprise a lesser amount.

The microbiological and biochemical characteristics of soil are the most complicated features of soil bio-diagnostics. Microorganisms are very sensitive indicators, as they sharply react to any various changes in the environment. This characteristic of the microbes is mostly reported in the literature. It has now been proved that the same group of microorganisms can perform even opposite physiological processes in different conditions, for example, denitrification and nitrogen fixation.

One of the significant environmental factors that have an impact on the effect on the activity of soil microorganisms is a salinization. When a large amount of salts are accumulated in soil because of salinity, it can reach a high salinity up to 6-7%. A large accumulation of salts in soil may cause to die of microorganisms, which
breaks the mechanism of soil fertility. But at the same time, it should be noted that soil microorganisms respond to the levels of salinity in soil in various way.

Microorganisms are an essential component of the biological cycle of energy and substances in the biosphere and in contrast to higher plants and animals, they have universal geochemical functions [13]. Without great and cumulative world of the inhabitant living in soil, there cannot be the soil itself [11, 12]. The knowledge of the patterns of development of microbial populations in soils is of great importance for understanding the true role of soil microflora in the ecosystem, as well as the intensity of its biochemical activity in certain natural conditions [2].

The formation of soil and its fertility is the result of the life activity of organisms which inhabit in soil. The essence of soil formation is the accumulation and enhancement of fertility in the primitive relatively infertile rock, which changes under the influence of those organisms in soil. Since microorganisms are the mandatory and most active representators in this process, the problem of fertility is legitimately considered as a microbiological [1].

The work of microorganisms can continuously raise the potential of soil fertility. Human activity can turn the potential wealth of soil into a real fertility that gives a high crop yields. Conditions that can create a high yields would improve soil properties, and make them more favorable for the life of some groups of microorganisms.

Depending on the amount of soil organic matter, certain types and doses of fertilizers affect the soil microorganisms unequally. Favorable conditions for development of soil microbiota can be created when such nutrients as calcium, magnesium, and potassium prevail in the soil. Strengthening of plant nutrition should occur not only through the application of fertilizers, however due to intensification of the activity of specific microorganisms developing in rhizosphere that able to transfer slightly soluble substances into forms that easily assimilated by plants.

Studies the bio-dynamics of soil microorganisms refer to determine the productivity of timely functioning of microorganisms, evaluation of dependence of the amount of microbial cells on environmental factors, setting of the features characterizing the dynamics of the amount of microorganisms, which will ultimately predict microbial productivity, and relative contribution of various groups of microorganisms into the whole biomass in soil.

The dynamics of microorganisms’ amount includes short-term and seasonal changes in their functioning over time. There is plenty of information available on the seasonal variability of microorganisms in literature [15]. Issue of studying the dynamics of soil microorganisms suggests both searching of practical approaches and find hypotheses that allow to interpreting the origin and nature of various changes in the number of microorganisms.

Major requirement of the need to studying the dynamics of abundance and biomass of soil microorganisms is accuracy and reliability of the data obtained that depend on what components of soil microbial complex are considered and what methods are used in order to count them. In soil fertility, agronomically important groups of soil microorganisms involved in the cycle of nitrogen and carbon play indispensable role. Their amount can be an indication of assessing the soil and identifying of the direction of the processes occurring in it.

Microorganisms can be found in any component of the environment; however most of them are available in the upper soil horizons. Despite the fact that the average mass of bacterial cell is only 7-9 x 10^{-14} g, their biomass in one hectare of virgin soil is estimated at 3-5 centners while the cultivated layer contains 2-5 tons of microorganisms [5,6]. It is known that bacteria are the most widespread forms of soils microorganisms. When counting bacteria using direct microscopic
calculation method by Vinogradsky, their amount in a gram of soil is estimated at billions. The number of bacteria in soil depends: first of all, on soil type and the period of its use in agricultural practices. This may also change with depth and seasonal fluctuations. Majority of bacteria are in the surface layers of soil (up to 30 cm) while less amounts in subsoil exist. Activity of bacteria is identified according to transformation of both organic (nitrogenous and nitrogen-free) substances and mineral compounds such as nitrogen, sulfur, phosphorus, iron etc. in soil.

Bacteria cause various transformations of mineral and organic substances especially of importance are such processes associated with nutrient release for plants while increasing soil fertility as ammonification, nitrification, nitrogen fixation, cellulose decomposition etc. Activity of bacteria may be restricted by such factors as moisture deficit and unfavorable temperature.

Therefore, intensive period of microbial activity cannot be judged in autumn and spring seasons. But, in summer a significant decrease in the number of bacteria is observable because of moisture lack and high temperature.

It must be noted that all mention above work state the main features of the soils in Mirzachool foot hill plain which are salinized by water soluble salts and gypsum. High salt and gypsum level in the soils develops unfavorable conditions for most soils which makes troubles in their possible amelioration. Obviously they were reported in the recent studies of the researchers from Uzbekistan and Russia [3,4,9,10,14,16,17,18].

**Results and Discussion.**

Ammonification is the first step of nitrogen cycle. Consequent result of vital activity of animals and plants, a large number of nitrogen-containing organic compounds fell on soil, which are susceptible to ammonification accompanied by the release of ammonia. Ammonification is carried out by ammonifying bacteria, as well as actinomycetes and micromycetes that largely dependent on the enrichment of soil with nitrogen-containing organic substances.

In particular conditions, the small amount of bacteria is due to lack of favorable moisture or temperature, on the other hand lack of organic substances may also lead to decrease in microbial activities. Another factor that has much effect on the number of bacteria is geographical distribution of soil type that creates largely dependent on the climate.

In describing the conditions, we indicated that studied soils of desert zone had sharp difference than the soils of sierozem belt by their agrochemical and physicochemical properties. Extremely unfavorable climatic conditions such as high summer temperature, low relative air humidity, high moisture evaporation from soil surface and low organic matter content are major limiting factors of microbiological processes in soil.

Our results revealed that the largest quantity of ammonifying bacteria growing on MPA medium are belonged to sierozem soils with an estimation in millions. The greatest number of ammonifiers was

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Research area and methods.

There are sierozem, meadow-sierozem, sierozem-meadow, solonchak, meadow and meadow-marsh soils with different salinity and gypsum level in Zarbdor district. Soil samples were taken from at 0-30, 30-50 and 50-70 cm depths for analyzes. Microbiological analyzes were carried out the day after of sampling day by MPN method.

Soils microflora is determined according to following methods: total number of microorganisms that assimilate organic nitrogen (ammonifiers) by meat-peptone-mahar (MPA). Special biological analyzes in soil samples were done during spring, summer, and autumn periods and were implemented by research group of the Center of AgroEcoBiototechnology at NUUz.
found in the spring period (Figure 1) that accounted from 600 to 1800 thousand per gram, while in summer under high temperature, this amount decreased slightly to 500-1710 thousand per gram. Surprising change was in the autumn that there was an increase in the number of bacteria from 550 to 1780 thousand per gram of soil in contrast to the summer period with the effect of the rainfall and new plant residues covered the soil.

The content of this group of microorganisms were greater in sierozem-meadow soils, where their limiting amount in the upper horizons reached at 760-1500 thousand per gram, and the smallest number was 300-550 thousand per gram of soil.

A regular decrease in the number of bacteria studied was observed, their number was higher in upper horizons (0-15 cm). Such distribution of ammonifiers through the profile is primarily related to the content of nitrogen-rich organic substances and plant residues, since these compounds are subject to an ammonification.

The poorest one of the amount of these microorganisms was in solonchaks where their number varied from 230 to 420 thousands per gram even falls from 100-290 to 60-90 thousands per gram of soil. Intermediate place on the number of ammonifiers are occupied by meadow soils with medium and strong salinity. Their number ranges from 220 to 670 thousand per gram in the soil profile. The largest quantity identified in the spring period while a smaller number is observed in the summer months.

Thus, microbiological studies showed that the seasonal dynamics of the amount of ammonifying bacteria in Djizakh steppe soils (thousands COE/per gram soil)

Figure 2. Seasonal dynamics of the amount of ammonifying bacteria in Djizakh steppe soils (thousands COE/per gram soil)

Thus, microbiological studies showed that the seasonal dynamics of the amount of ammonifying bacteria in typical sierozems had similarity in all of studied soils simultaneously.

Such distribution pattern perhaps is depended on the climatic features of the region, as in spring when moisture and temperature are optimal creates conditions for more sustaining of ammonifiers whilst in parallel of the decrease in moisture their number is significantly falls down in summer, but in autumn there can be seen a visible increase in the quantity of the bacteria studied.

Conclusion

Distribution of bacteria through the profile has certain pattern. Assessing the amount of bacteria growing on MPA showed that upper horizons are abundant...
of bacteria. When the depth increases, with a decrease in the number of bacteria are more likely appeared. This is mainly related on the decrease of organic matter content in soil as well as change in air regime etc. According to the pattern of distribution of humus through soil profile the increase in bacterial number are take place. Another last but not least factor which has direct influence on the number of bacteria is plant rooting system.

References