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## Changing Population by Aerobic Nitrogen-Fixing Bacteria in Natural and Anthropogenically Transformed Chernozems Biogeocenoses Central Ciscaucasia.

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### ABSTRACT

The article presents a study on the number of aerobic nitrogen-fixing bacteria *Azotobacter chroococcum* in seasonal dynamics of coupled plots of arable land and virgin soil of different subtypes of chernozems of the Central Ciscaucasia.

**Keywords:** azotobacter, chernozem, virgin land, tillage, winter wheat.

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## INTRODUCTION

Active human impact on the soil is often accompanied by increased development of negative processes and acceleration of further degradation of soil fertility. Intensive agricultural technologies may become a crucial factor in determining the environmental condition of the soil [2].

It has been established that many of the free-living bacteria (about 30 species) can fix molecular nitrogen. In the context of the Central Ciscaucasia in the soil is the most common *Azotobacter chroococcum*.

Microorganisms of the genus *Azotobacter* have increased sensitivity to humidity, temperature, pH, aeration and toxicity, which makes it possible to regard them as an indicator of soil ecological condition [3]. This microorganism enriches the soil by biological nitrogen and exist in a symbiotic relationship with all soil microorganisms.

The direction and intensity of soil-biological processes must be studied over time. The prospect of dynamic studies is that they allow you to expand our understanding of the quantitative change in microbiocenosis over time [1, 4].

## MATERIALS AND METHODS

The object of our research are the main subtypes of chernozems of the Central Pre-Caucasus: the southern, ordinary, leached (formed on the forest type loam), solonetzic and solonetzic-fusion (formed on eluvium Maikop clays of marine origin) associated areas of virgin land and arable land.

Taking soil samples and laboratory tests carried out in the seasonal dynamics on the main phases of winter wheat growing season: autumn, spring tillering, booting, flowering, milk ripeness, after harvesting the culture. On the virgin areas the research carried out at the same time as on an arable land. The vegetation of virgin land was presented forb-grass associations, on arable land sown winter wheat.

Sampling was carried out from the area of plant rhizosphere on virgin land in a layer of 0-8 cm, winter wheat from a layer of 0-20 cm by the usual method. The number of aerobic nitrogen-fixing bacteria was determined on a selective medium Ashby followed by direct counting of the colonies [5].

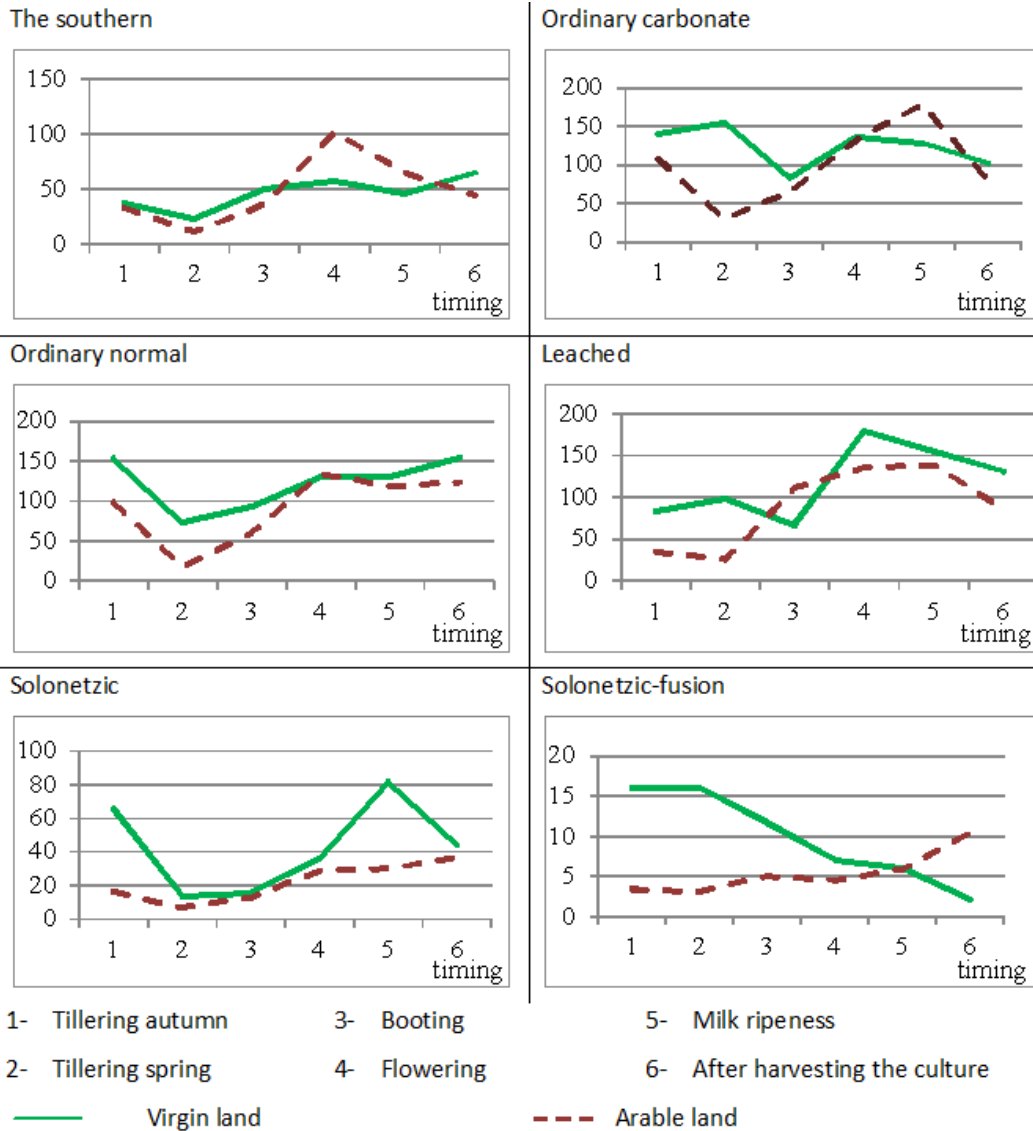
## RESULTS AND DISCUSSION

The population dynamics of aerobic nitrogen-fixing bacteria in the virgin lands area of southern chernozem is not observed a definite seasonal pattern (Figure 1). The lowest values in early spring are associated with low temperatures. During the season, you can observe an increase and a decrease in their number. In our opinion this is due to periods of wetting and desiccation, compression or decompression of soil.

On arable observed a clear pattern associated with the development phase cultural. The lowest value also falls on the phase of the spring tillering of winter wheat, followed by an increase of this indicator to the phases of booting and flowering, when the number of bacteria is maximal and amounts to 101,4 thous. CFU / 1g. The difference between the maximum and minimum values of 9.1 times compared to 2.5 times the virgin lands.

On calcareous chernozem ordinary, normal and leached observed the same pattern. It may be noted a general increase in the number of this group of microorganisms on these subtypes chernozem compared with southern chernozem. Most significantly it is expressed on the carbonate chernozem ordinary and less significant - on leached.

On chernozem solonetzic observed significant fluctuations in seasonal terms in the virgin lands area. The lowest value falls on the early spring, and the highest at the beginning of the summer and was 13.8 thousand, respectively. CFU / 1g and 81.6 thous. CFU / 1 g. The difference between the highest and lowest indicator was 5.9 times.



**Figure 1 - Seasonal dynamics of the number of aerobic nitrogen-fixing bacteria in the average vegetation phases, thousand CFU / 1g.**

On arable land solonetzic-merge occurs increase the number of aerobic nitrogen-fixing bacteria from early spring to the end of studies. The increase is less significant compared to the chernozem solonetzic and make up only 5.4 times.

On virgin land with solonetzic-fusion chernozem situation is the opposite. The highest rates are peculiar to autumn and early spring, and are within 16.0 thousand. CFU / 1g and 16.1 thous. CFU / 1g respectively. Then, during the growing season there is a reduction of the studied index, reaching the lowest values at the end of studies. The highest rates in the autumn and early spring periods associated with conducting tillage, which contributes to its loosening and improves physical properties. Sometimes the soil density was lower in this period than in the rest of the studied subtypes chernozems. Soils formed on the clay of marine origin, typical of a fairly rapid consolidation and as a consequence of reduction in porosity. Already in late spring period density can be regarded as unsatisfactory, and in the summer the soil is strongly compacted to 1.6 g / cm<sup>3</sup> or higher, as over consolidation, that gives reason to believe they merged. Porosity acquires a very low value (less than 50% and sometimes nearby 40%). Under these conditions, strict aerobes, which are microorganisms of the genus Azotobacter, significantly reduce their numbers.

Also noteworthy is the fact that if chernozems formed on loess deposits, the maximum number of Azotobacter was high (100-180 thousand. CFU / 1g), then on chernozem solonetzic does not exceed 82 thous.

CFU / 1g, and solonetzic-fusion 16 thousand. CFU / 1g. Thus, the decline in this indicator was more than 11 times. The lowest index of the number of microorganisms on solonetzic- fusion chernozem was only 2.2 thousand. CFU / 1g. This demonstrates the strong depression of Azotobacter and significant predominance of anaerobic conditions above aerobic.

The average number of Azotobacter kind of microorganisms on the southern chernozem varies by study years (Figure 2).

The average value for the entire period of studies shows that on an arable land the figure above virgin lands. The difference amounts to 7 thousand CFU / 1g at the maximum values of on an arable land 21 thousand CFU / 1g.

On chernozem ordinary carbonate no patterns by years of research, but the average number of nitrogen-fixing bacteria on virgin land exceeds a similar value on arable land. In addition, the average for all years of study, the studied index value is 1.5-1.7 times higher than in southern chernozem.

On chernozem ordinary and leached chernozem, there is a similar pattern with chernozem ordinary carbonate. This indicates a high nitrogen-fixing activity on this soil.

On chernozem solonetzic under winter wheat in all the years of research the number of aerobic nitrogen-fixing bacteria on virgin land is higher than on an arable land on average 2.0-2.2 times.



Figure 2 - Average number of vegetation aerobic nitrogen-fixing bacteria for years, thousand CFU / 1g.

A similar pattern is observed in the chernozem solonetzic-fusion. Consequently, for solonetzic and solonetzic-fusion chernozems created more favorable conditions for the development of aerobic nitrogen-fixing bacteria on virgin land, compared with arable land. Moreover, it should be noted that the total number of studied microorganisms at these subtypes is considerably lower compared with other soils and especially at chernozem solonetzic-fusion. Thus, the minimum and maximum values range from 2.8 thous. CFU / 1 g to 11.9 thous. CFU / 1 g. On chernozems formed on loess loam, this rate is much higher and amounts to, for example, on chernozem ordinary carbonate 33 thousand. CFU / 1g and 187 thous. CFU / 1g respectively.

### CONCLUSION

Thus, the number of microorganisms on Azotobacter kind of arable land are significantly higher and seasonal dynamics significantly more pronounced compared to the virgin land. This, of course, affect the soil productivity and environmental sustainability.

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