ISSN: 0975-8585

Research Journal of Pharmaceutical, Biological and Chemical Sciences

Number And Biodiversity Of Microscopic Fungi Of Chernozems Of Virgin Soil And Arable Land Of Central Ciscaucasia.

Valerii Sergeevich Tshovrebov*, Vera Ivanovna Faizova, Dmitry Vasilivich Kalugin, Anastasia Mikhailovna Nikiforova, and Vera Yaroslavovna Lysenko.

Stavropol State Agrarian University, Zootekhnicheskiy lane 12, Stavropol 355017, Russia.

ABSTRACT

This article describes the results of many years of research on the state of microscopic fungi in the soils of the chernozem zone of the Central Ciscaucasia. A comparative analysis of their abundance in the adjoining areas of virgin land and arable land of various subtypes of chernozems is carried out. The species diversity of micromycetes has been studied. It has been established that the number of fungi in the chernozems of southern, leached, ordinary and carbonate in the plowland is higher than in the adjoining areas of virgin soil. The number of the studied group of microorganisms on chernozem solonetsous and solonetsous-fusions increases significantly on the virgin land. The generic composition of microorganisms on virgin land is more diverse than in arable land.

Keywords: micromycetes, chernozems, abundance, diversity, winter wheat.

Corresponding author

ISSN: 0975-8585

INTRODUCTION

Central Ciscaucasia is located at the foot of the Greater Caucasus Mountains on the border of the forest-steppe and steppe natural zones. A complex combination of relief and natural climatic conditions predetermined the formation of a variegated soil cover of this territory. The number of microorganisms is the factor that is determined by many parameters, including humidity, temperature, nutrient content, soil acidity, etc. [6-8].

In conditions of active anthropogenic transformation of landscapes, the detection of the diversity of microscopic fungi, adapted to specific ecological conditions, is of particular importance. Micromycetes are present in all biocenoses. Possessing a powerful enzymatic apparatus, the fungi in the course of their life creates an environment rich in metabolic products [3]. They are one of the main links of food chains and carry out a number of key functions in ecosystems, such as participation in processes of organic matter decomposition and nutrient cycling, regulation of structure and degree of activity of soil microflora. Interest in this physiological group of microorganisms is very great in connection with their practical importance for agricultural production [10]. The purpose of our study is to analyze the change in the number and taxonomic diversity of micromycetes of the main subtypes of the chernozems of the Central Ciscaucasia when they are involved in agricultural production.

MATERIALS AND METHODS

The object of research are various subtypes of chernozems of Central Ciscaucasia: southern, ordinary and leached. Among the common chernozems, genera are distinguished and studied: ordinary, solonetzic and solonetsous-fused. The southern, common and leached chernozems are formed on loesslike loams, solonetsous and solonetzic-fused on the eluvium of Maikop clays.

Observations were conducted from 2004 to 2012 in key areas of virgin land and arable land. Winter wheat was sown in the plowed field. The virgin grass is represented by a herbage-grass association. Sampling of soil samples was carried out from the rhizosphere of plants on virgin soil in the 0-8 cm layer, in winter wheat from the 0-20 cm layer according to the generally accepted method (Methods of soil microbiology ..., 1991), observing the principle of one-stage studies. Of the 5-7 point samples, the average sample was made. The number of micromycetes (total number of colony forming units - CFU) was studied by seeding the soil suspension in a dilution of 10^{-2} on a Czapek-Dox medium acidified with citric acid and adding 100 µg / ml of streptomycin to inhibit the growth of bacteria followed by direct colony counting. Identification of fungi was carried out on the basis of culture-morphological characters according to traditional determinants [1, 2].

Dedicated micromycetes were characterized by the degree of their diversity, for the characterization of which the index of species wealth was used (Shannon coefficient) [4, 5]. The variety is considered very low at a value of less than 1, with a coefficient of more than 2 the community of micromycetes is considered rich. Statistical processing of data was carried out using the Microsoft Excel program.

RESULTS AND DISCUSSION

During the long-term studies, differences between virgin and arable land of different subtypes of chernozems were revealed when comparing the average number of micromycetes (Fig. 1). It has been established that the number of microorganisms on arable land on chernozems leached, ordinary and carbonate is slightly higher than in virgin land, by 18, 9 and 34 thousand CFU / g or by 1.1-1.3 times, respectively. In southern chernozem, the increase in the indicator studied in arable land is 1.9 times higher than in the virgin land.

ISSN: 0975-8585

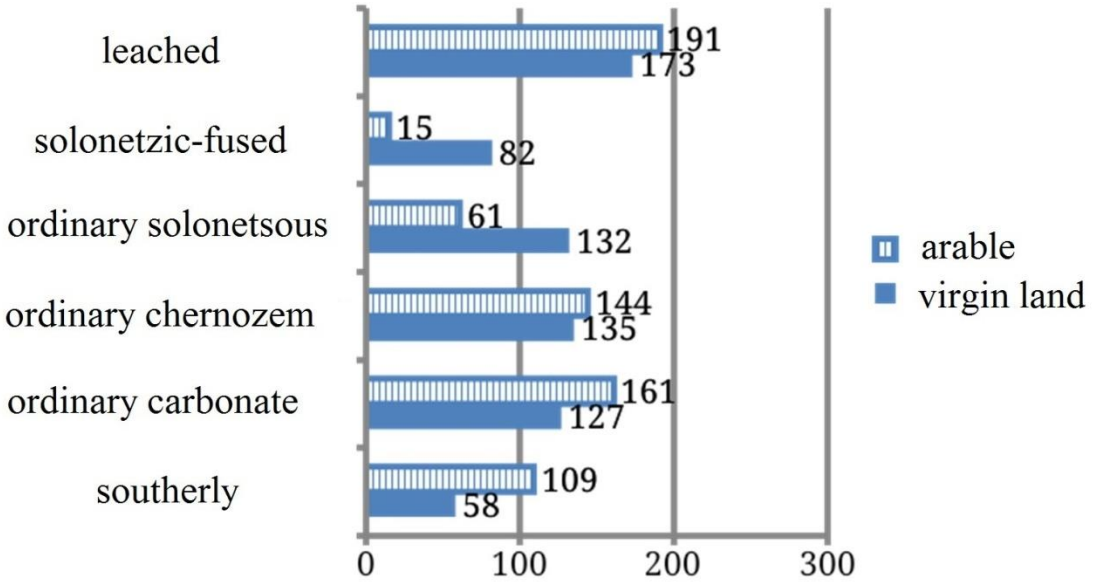

Figure 1: Average number of micromycetes on virgin soil and plowland under winter wheat in various subtypes and genera of chernozems, thousand CFU / 1 g

In the key areas of alkaline and solonetzic-fused chernozems, the picture changes sharply. On solonetsous soils, the number of micromycetes on virgin soil is 2.2 times higher than on arable land. On chernozem solonetsous-fused, the difference between virgin land and arable land is even more significant and is 5.5 times. We believe that fungi, being strict aerobes, develop much better in conditions of low density and good aerritibility, which are characteristic of virgin tracts [9]. According to preliminary studies, a considerable consolidation and decrease in the porosity of the upper horizons occurs, and especially on chernozem solonetsous-fused, which guarantees their weak aeration and the development of anaerobic processes. This adversely affects the development of microorganisms of a given physiological group and is the main reason in establishing this pattern.

It is established that the average number of micromycetes per vegetation on the virgin land of leached chernozem is 173 thousand CFU / 1 g of soil. This is more than in ordinary chernozem of various genera in 1,3-1,4 times, on chernozem solonetsous-fused in 2,1 times and on chernozem southern in 3,0 times. The number of microorganisms of this physiological group on the leached chernozem chernozem reaches 191 thousand CFU / 1 g of soil and exceeds the similar parameters of the arable plots of ordinary black carbonate chernozems, common solonets and southern soils, respectively, 1.2; 1.3; 3,1 and 1,8 times. On the arable land of solonetzic-fused chernozem, the average number of micromycetes in the vegetation is only 15 thousand CFU / 1 g of soil, which is 12.7 times lower than on leached chernozem.

In our studies, a certain interest is the diversity of micromycetes under natural conditions and in agro enosis (Figure 2). This indicator may indicate the influence of anthropogenic factor on the indicator under study. The more diverse soils are in terms of microbial composition, the more environmentally sustainable they are, less prone to soil and highly fertile.

It has been established that on all studied subtypes of chernozems the coefficient of diversity on the virgin soil considerably exceeds this index on the plow land. So, for example, on southern chernozem the greatest value of the investigated value was in 2006 and 2012 and coincided with periods of better moisture. In virgin land, this figure was 1.64 and 1.88 units, and in the arable land it was 1.24 and 1.56 units, respectively, for years.

ISSN: 0975-8585

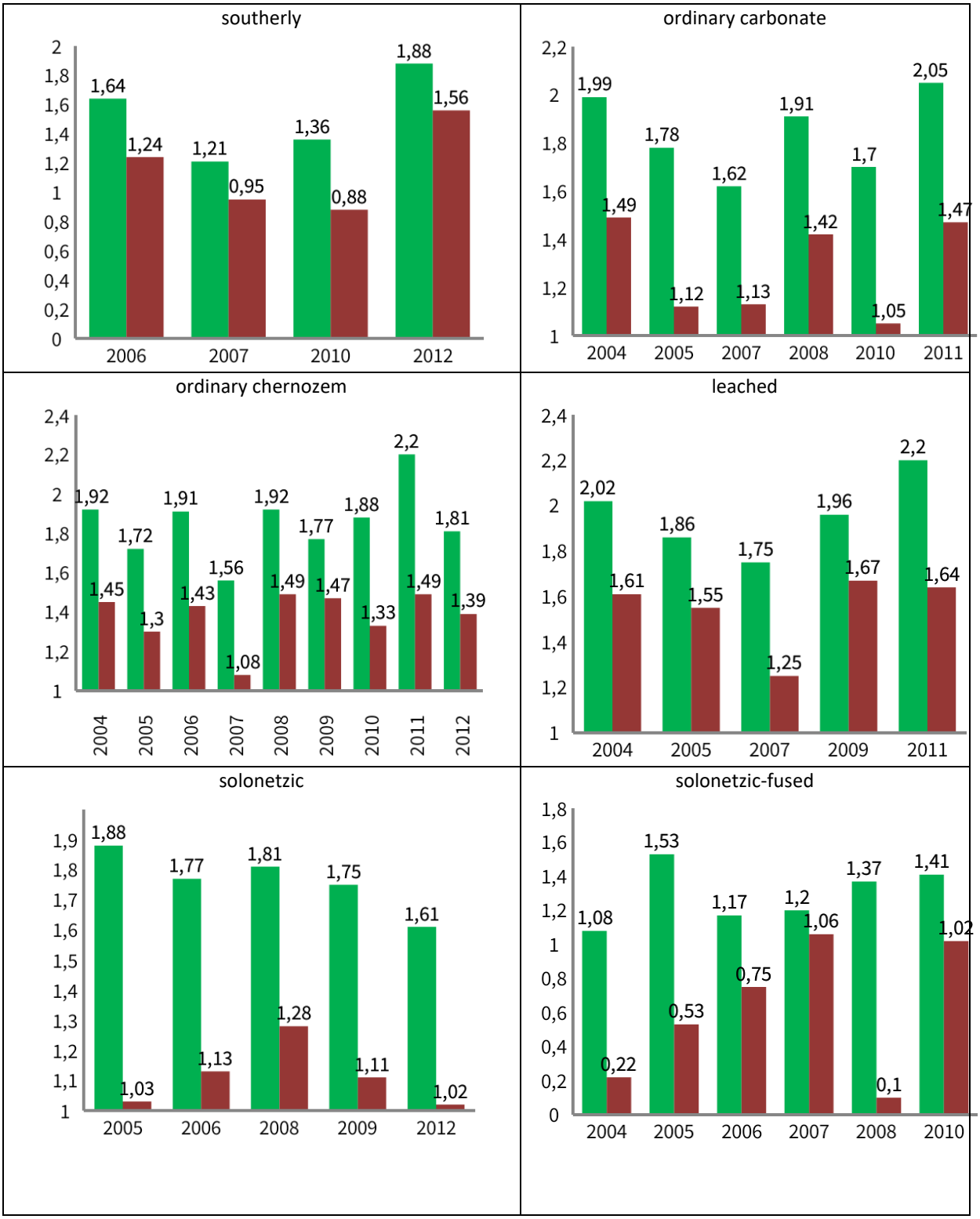

Figure 2: Coefficient of micromycete diversity (according to Shannon) by year of study

On ordinary chernozem black carbonate the difference is even more significant and reaches 0.5 units in 2004, and in 2005 - 0.66 units. This difference can be considered the greatest. In addition, in 2011, the Shannon coefficient for virgin land was 2.05 units, in which mushroom diversity can be considered rich.

A similar pattern is observed in the other subtypes of chernozems. It is noteworthy that on ordinary chernozems ordinary and leached, as well as on chernozem, the Shannon coefficient is about two or more than 2 units.

On the plowed field, the coefficient studied is usually less than 1.5 and is close to unity.

If we analyze these values by years, then the studied indicator on the plow land falls to values below 1. This phenomenon was not observed in the virgin soil during all the years of research.

A similar picture is also observed on chernozems formed on the eluvium of Maikop clays. Unlike chernozems formed on loess like loams, the values of the diversity coefficient are somewhat lower here on solonetsous soils and are further reduced by solonetsous-fused ones. So, on the chernozem solonetsous-fused diversity coefficient according to Shannon on virgin soil is very close to 1, but if you analyze this indicator on arable land, its value tends to zero. In 2004, it was only 0.22 units and was 5 times lower than in the virgin land. In 2008, the coefficient was 0.1 units and was 13 times lower compared to the virgin land. All this testifies to the huge environmental press that the microbial community is experiencing in the plow land. Monotony of cultures and their rooting form a less diverse microbial community, as evidenced by the diversity ratio according to Shannon. The data cited indicate the possibility of the onset of fatigue on the plow and, consequently, the decrease in the productivity of agricultural crops.

CONCLUSION

Thus, when analyzing the number of micromycetes, a regular increase in their number on plow land was revealed, as compared with the virgin soil in chernozems: 1.9 times in the south, 1.3 times in ordinary carbonate, 1.1 times in ordinary and leached. On chernozem, solonetsous and solonetsous-fused, on the contrary, the amount of fungi on virgin soil exceeds the analogous index in arable land by an average of 2.2 and 5.5 times, respectively.

The average perennial number of microorganisms on the virgin soil of the leached chernozem is the highest and exceeds the analogous index in the other investigated soils by 1.3-3.0 times. In the agro enosis of winter wheat, the leached chernozem also revealed the largest number of micromycetes, which is 1.2-12.7 times higher in comparison with other soil varieties studied.

The virgin soils show a greater variety of soil micro flora and, consequently, its high ecological stability. Arable land largely loses the variety of micromycetes, and this, in our opinion, will be one of the main causes of the onset of soil fatigue in agrocenoses.

REFERENCES

[1] Bilai V.I., Koval E.Z. Aspergilla. The determinant // Kiev: Naukova Dumka, 1988. - 204 p.
[2] Litvinov, M.A., Determinant of microscopic soil fungi, M .: Izd-vo Nauka, 1967, p. 310
[3] Mirchink T.G. Soil fungi as a component Soil microorganisms as components of biogeocenosis // M .: Izd-vo Nauka, 1984. - p. 114-131.
[4] Megarran E. Ecological diversity and its measurement // Moscow: Mir, 1992. - 184 p.
[5] Shannon K. Works on the theory of information and cybernetics / K. Shenon. - Moscow: Publishing House of Foreign Literature, 1963. - 830 p.
[6] Emelyanov S.A., Mandra Y.A., Gudiev O.Y., Maznitsyna L.V.,Korostylev S.A. Effects of Anthropogenic Environmental and Food Safety // Research Journal of Pharmaceutical, Biological and Chemical Sciences. 2016. Volume 7. Issue 3. p. 2562 - 2569.
[7] Agrochemical Principles of Targetting Winter Wheat Yield on Leached Chernozem of the Stavropol Elevation / A. N. Esaulko, M.S. Sigida, E.A. Salenko, S.A. Korostylev, E.V. Golosnoy // Biosciences Biotechnology Researhc Asia, April, 2015, Vol.12(1), p. 301-309.
[8] Vlasova, O.I., Perederieva, V.M., Volters, I.A., Tivikov, A.I., Trubacheva, L.V. Change in microbiological activity under the effect of biological factors of soil fertility in the central forecaucasus chernozems// Biology and Medicine . 2015. 7 (5), BM-146-15.

[9] Tshovrebov, V.S., Faizova, V.I., Kalugin, D.V., Nikiforova, A.M., Lysenko, V.Y. Changes in the content of organic matter in black soils of Central Ciscaucasia caused by their agricultural use// Biosciences Biotechnology Research Asia. 2016. 13 (1), p. 231-236.

[10] Nickerson K., Atkin A. L., Hornby J. M. Quorum Sensing in Dimorphic Fungi: Farnesol and Beyond // Applied environmental microbiology. 2006. V. 72. № 6. p. 3805−3813.

[11] Natal'ja Jur'evna Sarbatova, Vladimir Jur'evich Frolov, Olga Vladimirovna Sycheva and Ruslan Saferbegovich Omarov. Res J Pharm Biol Chem Sci 2016;7(2):534-538.

[12] Vladimir Sadovoy, Ruslan Omarov, Sergei Shlykov, Tatiana Shchedrina. Assessment of compliance of qualitative food characteristics to standard requirements. Proceedings of 15th International Scientific Conference Engineering For Rural Development Proceedings. 2016; Volume 15, pp. 360-363.

[13] Ruslan Omarov, Ivan Gorlov, Vladislav Zakotin, Sergei Shlykov. Development of marble beef technology. Proceedings of 16th International Scientific Conference ENGINEERING FOR RURAL DEVELOPMENT Proceedings. 2017; Volume 16, pp. 956-959.

[14] Ruslan Omarov, Alexander Agarkov, Evgeny Rastovarov, Sergei Shlykov. Modern methods for food safety. Proceedings of 16th International Scientific Conference ENGINEERING FOR RURAL DEVELOPMENT Proceedings. 2017; Volume 16, pp. 960-963.

[15] Ivan Fedorovich Gorlov, Ruslan Saferbegovich Omarov, Marina Ivanovna Slozhenkina, Elena Yuryevna Zlobina, Natalia Ivanovna Mosolova, and Sergei Nikolaevich Shlykov. Res J Pharm Biol Chem Sci 2017;8(6):744-750.

[16] Natal'ja Jur'evna Sarbatova, Vladimir Jur'evich Frolov, Tatyana Aleksandrovna Ruleva, Olga Vladimirovna Sycheva, and Ruslan Saferbegovich Omarov. Res J Pharm Biol Chem Sci 2017;8(1):1091-1095.

[17] Natal'ja Jur'evna Sarbatova, Vladimir Jur'evich Frolov, Olga Vladimirovna Sycheva and Ruslan Saferbegovich Omarov. Res J Pharm Biol Chem Sci 2016;7(2):1539-1543.