PROCEEDINGS OF THE YEREVAN STATE UNIVERSITY

Chemistry and Biology 2022, **56**(3), p. 253–258

Biology

MICROMYCETES OF CONTAMINATED SOILS AROUND KAJARAN CITY (ARMENIA)

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In the current research, we investigated soil micromycetes-decomposers around Kajaran City. As a result of the studies, 30 micromycetes were identified as belonging to 16 genera of which 1 belongs to Basidiomycota, 1 – to Mortierello-mycota, 3 – to Mucoromycota, and 11 – to Ascomycota. Changes in the species composition and some morphological features of soil fungi are observed depending on the industrial pollution.

https://doi.org/10.46991/PYSU:B/2022.56.3.253

***Keywords*:** contaminated territory, soil fungi, micromycetes, dilution method, copper-molybdenum plant.

Introduction. Assessment of the impact of economic or other activities on the environment is one of the most effective forms of environmental management and control. It is aimed at preserving the quality of the environment, sustainable economic development, and environmental safety of the population. This was facilitated by the signing and ratification of 17 international environmental conventions by the Republic of Armenia [1].

It is known that the main sources of industrial soil pollution are wastes from smelters, oil and other enterprises. This pollution can harm both the physical and chemical composition of the soil as well as biological properties and negatively affect biodiversity including the development of soil-microscopic fungi and changing their species composition. It should be noted that soil microscopic fungi (micromycetes) belong to organisms with very high ecological plasticity and wide distribution. They can develop in various climatic zones even under the extreme conditions: from permafrost and areas with high radiation levels to hot springs.

Mining is one of the main sources of environmental pollution by heavy metals. Considering the fact that the mining industry is one of the main branches of the industry of the Republic of Armenia, this issue is very urgent [2].

To date, soil fungi are one of the little-studied components of biocenosis in the world and in specific regions [3, 4], for example in RA.

Studies of soil fungi in Armenia were conducted in 1961 by J.H. Abrahamyan. She investigated micromycetes in the contaminated soil near factories, industrial enterprises, and other places in some regions of Armenia: Kirovakan, Hrazdan, and

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Hoktemberyan Cities. We started mycological studies of the soil fungi in Syunik in 2017 [5]. Below presented information about investigation of soil fungi from Kajaran, which located in Syunik Region.

Materials and Methods. The type of soils in the territory of Kajaran is characterized by carbonate mountain cambisol [6]. For mycological studies of soil micromycetes, 8 soil samples were taken from different observation points: Kajaran village, Kajaran City and Geghk Reservoir, last of which was taken from pure place (Tab. 1). All the important notes, such as date, location and depth, horizon of the soil, etc. were made after sampling [7].

Table 1

Investigated research areas

Name of the viewpoint	Viewpoint location	Characteristic of the viewpoint	Sampling coordinates, N/Lat E/Long	Altitude above sea level, *m*
12-QV	Kajaran village	cultivated area	N39° 09,596′ E46° 07,075′	1992
13-QV		cultivated area	N39° 09,485′ E46° 07,588′	1920
14-QS	Kajaran City	the grassy area in the yard of №2 school	N39° 09,002′ E46° 09,363′	1818
15-QS		the grassy area in the yard of №1 school	N39° 08,990′ E46° 09,806′	1748
16-QS		public area (square in the centrum of the)	N39° 09,080′ E46° 09,581′	1770
17-QS		the grassy area in the yard of kindergarten	N39° 09,012′ E46° 09,990′	1722
20-CONT	Geghk Reservoir	near Geghk Reservoir, natural landscape	N39° 13,033′ E46° 13,947′	1353

The Petri dishes with agar medium were inoculated with the previously diluted soil samples (Fig. 1) [5]. The pure culture of fungi was carried out at a temperature 23–25℃ during 7–14 days.

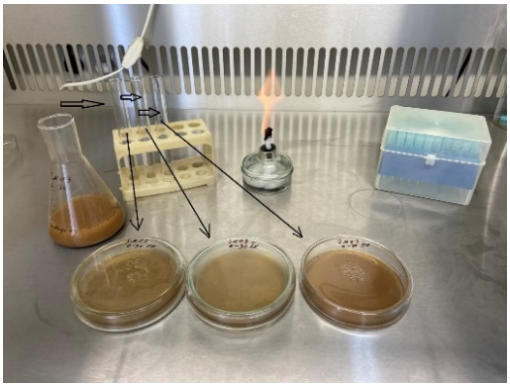

Fig. 1. Scheme of inoculation.

Identification of soil microscopic fungi were done by using the guides [8–12]. Species modern names have been verified using the Mycobank database nomenclature (https://www.mycobank.org/).

Results and Discussion. As a result of the studies, 30 micromycetes were identified as belonging to 16 genera, of which 1 belongs to the division Basidiomycota, 1 – to Mortierellomycota, 3 – to Mucoromycota, and 11 – to the division Ascomycota (Tab. 2).

The identification of species was carried out by taking into account morphological characteristics and culture specifications.

From the Tab. 2 it can be seen that the main portion of the genera (11 genera) belongs to the division Ascomycota.

Representatives of the genera *Aspergillus*, *Penicillium* and *Fusarium* predominate in investygated soils (diag. below). However, the genus *Aspergillus* differs from others in its species diversity. Dark-colored (melanized) species of the genus *Cladosporium* (*C. lignicola, C. herbarum*) indicate some soil contamination (Fig. 2).

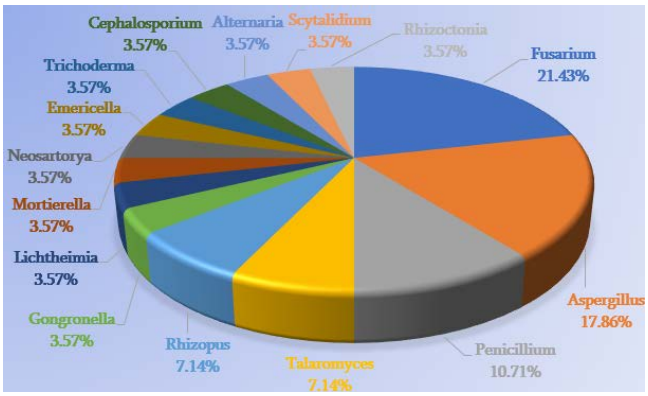

Fig. 2. Percent of fungi separated from the soil.

Some authors note that a significant indicator of soil contamination is a change in the number of light-colored fungi in the species composition of fungi. However, there is evidence that different industrial enterprises affect this indicator in different ways, for example, waste from copper plants contributes to the growth of dark-colored fungi and aluminum waste, on the contrary, prevents the development of these fungi (Korneikova, Lebedeva, 2016) [13]. In our studies, there is a quantitative difference between light- and dark-colored micromycetes. As a result of investigation, we can note that the dark-colored micromycetes predominate (Fig. 3).

Fig. 3. Light and dark-colored soil fungi.

Table 2

Systematic analysis of mycobiota, isolated from the studied soil samples

Division	Class	Order	Family	Genus	Species
Mucoro-mycota	Mucoro-mycetes	Mucorales	Cunning-hamellaceae	*Gongronella*	G. butleri (Lendn.) Peyronel & Dal Vesco
			Lichtheimiaceae	*Lichtheimia*	*L. ramosa* (Zopf) Vuill.
			Mucoraceae	*Rhizopus*	*Rh. microsporus* Tiegh.
					Rh. stolonifer (Ehrenb.) Vuill.
Mortierello-mycota	Mortierello-mycetes	Mortierellales	Mortierellaceae	*Mortierella*	*M. polycephala* Coem.
Ascomycota	Eurotio-mycetes	Eurotiales	Aspergillaceae	*Aspergillus*	*A. flavipes* (Bainier & Sartory) Thom & Church
					A. niger Tiegh.
					A. ochraceus K. Wilh.
					A. restrictus G. Sm.
					A. wentii Wehmer
			Trichocomaceae	*Neosartorya*	*N. clavata* (Desm.) Pitt & A.D. Hocking
				Emericella	*E. versicolor* (Vuill.) Pitt & A.D. Hocking
				Talaromyces	*T. diversus* (Raper & Fennell) Samson
					T. duclauxii (Delacr.) Samson
				Penicillium	*P. adametzii* K.W. Zaleski
					P. lanosum Westling
					Penicillium sp. Link
	Sordario-mycetes	Hypocreales	Hypocreaceae	*Trichoderma*	T. koningii Oudemans
			Insertae sedis	*Cephalosporium*	*C. glutineum* Kamyschko
			Nectriaceae	*Fusarium*	*F. avenaceum* (Fr.) Sacc.
					F. concolor Reinking
					F. poae (Peck) Wollenw.
					F. chlamydosporum Wollenw. & Reinking
					F. tricinctum (Corda) Sacc.
					F. incarnatum (Roberge ex Desm.) Sacc.
		Pleosporales	Pleosporaceae	*Alternaria*	*A. alternata* (Fr.) Keissl.
		Cladosporiales	Cladosporiaceae	*Cladosporium*	*C. lignicola* Corda
					C. herbarum (Pers.) Link
	Leotio-mycetes	Helotiales	Insertae sedis	Scytalidium	*S. flavobrunneum* (J.H. Mill., Giddens & A.A. Foster) Sigler
Basidio-mycota	Agarico-mycetes	Cantharellales	Ceratobasidiaceae	*Rhizoctonia*	*R. solani* J.G. Kühn
4	6	8	11 (2 insertae sedis)	16	30

Growth of colonies of dark colored micromycetes from division Ascomycota (Alternaria alternata) and species from division Basidiomycota (Rhizoctonia solani) was also observed in the control soils.

In polluted soils there are also accumulations of conditionally pathogenic (opportunistic) fungi, which can negatively affect both the composition of the soil and disrupt food chains causing harm to human health. In connection with the impact of industrial pollution (including the copper-molybdenum plant) on the structure of the micromycetes soil complex, changes in the morphological and physiological characteristics of soil fungi were revealed. As a result of mycological studies, it was not possible to determine a single species belonging to the genus Penicillium, because the conidia were subjected to serious changes, which may have been of an adaptive nature, since it is known that the structure of the conidial system of fungi in polluted environments and extreme conditions is often modified [14].

Based on the results of our studies, it can be generally stated that the control soil does not contain potentially pathogenic species of micromycetes.

Received 14.10.2022
Reviewed 09.11.2022
Accepted 09.12.2022

REFERENCES

1. Gevorgyan S., Petrosyan R., Gevorgyan A. Environmental Security Issues in RA. *Amberd Series S. Economist.* (2014) 50 p.
2. Ghazaryan K., Movsesyan H., et al. Geochemistry of Potentially Toxic Trace Elements in Soils of Mining Area: a Case Study from Zangezur Copper and Molybdenum Combine, Armenia. *Bull. Environ. Contam. Toxicol.* **101** (2018), 732–737.
3. Tedersoo L., Bahram M., Polme S. et al. Global Diversity and Geography of Soil Fungi. *Science* **346** (2014), 256688. https://doi.org/10.1126/science.1256688
4. Dai Y.-C., Cui B.-K., et al. Dynamics of the Worldwide Number of Fungi with Emphasis on Fungal Diversity in China. *Mycol. Progress* **14** (2015), 62. https://doi.org/10.1007/s11557-015-1084-5
5. Matevosyan R.E., Nanagulyan S.G., et al. Study of Soil Fungi in the Territory of Kapan City and Their Surrounding. *Proc. of the YSU B: Chem. and Biol. Sci.* **52** (2018), 193–167. https://doi.org/10.46991/PYSU:B/2018.52.3.193
6. Ghazaryan K.A., Movsesyan H.S., et al. General Characteristic and Pollution Level of Soils in Ecologically Vulnerable Mining Areas around Kapan Town in Armenia. *Academic Journal of Science, CD-ROM* **03** (2014), 187–196.
7. Kurakov A.V. *Methods for Isolating and Characterizing Complexes of Microscopic Fungi in Terrestrial Ecosystems.* Moscow, MAKS Press (2001), 92 p.
8. Pidoplichko N.M. *Penicillium.* Kiev, Naukova Dumka (1972), 150 p. (in Russian).
9. Pidoplichko N.M., Milko A.A. *Atlas of Mucoral Fungi*. Kiev, Naukova Dumka (1971), 115 p. (in Russian).
10. Litvinov M.A. *Determinant of Soil Microscopic Fungi.* Leningrad, Nauka (1967), 303 p. (in Russian).
11. Bilai V.I., Koval E.Z. *Aspergillus.* Kiev, Naukova Dumka (1988), 390 p. (in Russian).
12. Koval E.Z., Rudenko A.V., Voloshuk N.M. *Penicillium.* Kiev, NNIRXV (2016), 407 p. (in Russian).

13. Korneikova M.V., Lebedeva E.V. Mycobiota of Surface Air in Various Natural and Industrial Zones of the Murmansk Region. *Mycology and Phytopathology* **51** (2017), 203 – 210.
14. Kirtsideli I.Yu. *Microscopic Fungi in Soils and Soils of Arctic Mountain Systems.* Komarov Botanical Institute of the Russian Academy of Sciences. St. Petersburg (2015), 16 p.

Ռ. Է. ՄԱԹԵՎՈՍՅԱՆ

ՔԱՋԱՐԱՆ ՔԱՂԱՔԻ ՇՐՋԱԿԱՅՔԻ ԱՂՏՈՏՎԱԾ ՀՈՂԵՐԻ ՄԻԿՐՈՄԻՑԵՏՆԵՐԸ (ՀԱՅԱՍՏԱՆ)

Այս աշխատանքում մենք ուսումնասիրել ենք Քաջարան քաղաքի շրջակայքի հողերի միկրոմիցետները: Ուսումնասիրությունների արդյունքում հայտնաբերվել է միկրոմիցետների 30 տեսակ՝ 16 ցեղ, որից 1-ը պատկանում է բազիդիոմիցետներին, 1-ը մորտիերելլամիցետներին, 3-ը՝ մուկորոմիցետներին, 11-ը՝ ասկոմիցետներին: Արդյունաբերական աղտոտումների ազդեցության հետ կապված նկատվում են հողային սնկերի տեսակային կազմի և որոշ մորֆոլոգիական առանձնահատկությունների փոփոխություններ:

Р. Э. МАТЕВОСЯН

МИКРОМИЦЕТЫ ЗАГРЯЗНЕННЫХ ПОЧВ, СОБРАННЫЕ ВОКРУГ ГОРОДА КАДЖАРАН (АРМЕНИЯ)

В данной работе изучались почвенные микромицеты-редуценты, собранные вокруг города Каджаран. В результате исследований выявлено 30 видов микромицетов из 16 родов, из которых 1 относится к базидиомицетам, 1 – к мортиерелламикотам, 3 – к мукоромицетам и 11 – к аскомицетам. Из-за воздействия промышленных загрязнений наблюдаются изменения видового состава и некоторых морфологических особенностей почвенных грибов.