

New Fungi Species for Azerbaijani Nature

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Abstract

The presented work is devoted to the general characteristics of species that have been recently recorded during the study of the mycobiota of various ecosystems (water, soil, plants) of the Republic of Azerbaijan and are new to the nature of Azerbaijan. In this regard, out of about 190 species recorded in the conducted studies, species such as *Alternaria consortialis*, *Gliomastix murorum*, *Monilia pistaciae*, *Papularia roseum*, *Penicilium atrovenetum*, *P. clavigerum*, *P. duclauxii*, *P. palitans* and *P. viridicyclonium* were recorded for the first time in the territory of Azerbaijan.

Keywords: water, soil, plant, mycobiota, new species

INTRODUCTION

As in the whole world [4], in the Republic of Azerbaijan, anthropogenic impacts on the environment have been increasing in recent times, which primarily affects living beings [17]. This is no coincidence, so that among these impacts, one of the most global problems today is precisely the loss of biodiversity. Preventing this has become one of the important tasks of modern biological science and its separate fields that study living things (botany, zoology, mycology, microbiology, etc.) [3, 5]. Thus, it has been confirmed in studies that the functioning and sustainability of any ecosystem is a matter of the richness of the species diversity of the living beings inhabiting it [8]. In solving these problems, the main task is, first of all, to assess the biota of a given ecosystem, determine

their species composition, determine their ecotrophic relationships, and clarify other issues.

Fungi are one of the most important groups of living organisms, widely distributed in various ecosystems. Thus, although the number of species of fungi, which are one of the permanent components of the heterotrophic block of any ecosystem, currently known to science is around 150 thousand [10, 16], the actual number in nature is likely to be many times greater [7, 20], and this is generally accepted by the scientific community. This fact alone allows us to confidently state that determining the species composition of fungal biota characteristic of ecosystems is a pressing task.

The rich nature of the Republic of Azerbaijan has created conditions for the spread of fungi in its territory [1-2, 14], which has led to the spread of thousands of fungal species in its nature, and among them, the presence of species new to both science and local mycobiota has been noted. However, the current studies, which include both local mycobiota and species new to science allows to note that the study of the fungal biota characteristic of the country is weak.

Therefore, the aim of the presented work was to identify species new to the nature of the country among the fungi recorded in the research conducted in different ecosystems of Azerbaijan and to study some of their cultural and morphological characteristics.

Material and methods

The research was conducted in the territories of the Greater Caucasus, Lesser Caucasus and the Kur-Araz lowland of the Republic of Azerbaijan. Samples for the study were taken from both soils and plants, including fruit plants, using classical mycological methods and analyzed for fungal biota in accordance with the purpose of the study.

For the isolation of fungi, were used standard nutrient media, more precisely agarized malt juice (AS), Sabouraud agar (SA), Potato agar (KA), etc., that their preparation, sterilization, and pouring into Petri dishes were carried out on the basis of general principles accepted in microbiology and mycology [13].

When determining the species composition of fungi, were used descriptive and color atlases prepared by L.V.Garibova [6], P.M.Kirk et al. [11], D.W.Lee et al. [12] and D.Sutton [18]. The taxonomic affiliation and current name of the fungi whose species composition was determined were confirmed based on the data on the official website of the International Association of Mycology [9].

Results and discussion

As a result of the analysis of nearly 1,000 samples taken from soils, cultivated and wild plants in various territories of the Republic of Azerbaijan in 2017-2024, the distribution of 211 fungal species was revealed, the taxonomic affiliation of which is given in Table 1. As can be seen, most of the recorded

fungi, i.e. 75.4%, belong to the ascomycetes, 6.6% to the mucormycetes, and 18.0% to the basidiomycetes.

The fungal species recorded in the studies are characterized by a wide diversity in terms of genera and distribution on substrates, ecotrophic

Table 1. Numerical general characteristics of the taxonomic structure of fungi recorded in studies

Kingdom	Subkingdom	Division	Class	Order	Family	Genus (species)
<i>Mycota</i> or <i>Fungi</i>	<i>Mucor- myceta</i>	<i>Mortierellomycota</i>	1	1	1	1(2)
		<i>Mucormycota</i>	1	1	1	4(12)
	<i>Dikarya</i>	<i>Ascomycota</i>	6	10	15	43(159)
		<i>Bazidiomycota</i>	4	7	11	17(38)
Total	2	4	12	19	28	65(211)

relationships, as well as the forms of manifestation of ecotrophic specialization. For example, among the fungal genera recorded in studies, the genus *Penicillium* is represented by the largest number of species, so the number of species belonging to this genus among the fungi recorded in studies is 45. In this regard, the number of species of genera such as *Arthrobotrys*, *Aspergillus*, *Alternaria* and *Trichoderma* in the following places varies between 10-23 species. The number of species belonging to the remaining genera varies between 1-8. It should be noted that phytopathogens, toxigens, endophytes, and epiphytes are found among registered fungi that is, the registered fungi are characterized by a wide diversity in these aspects.

During the investigation of the distribution of fungi recorded in the conducted studies in the nature of Azerbaijan, it became clear that most of them are species whose distribution has been recorded in one or other studies, but among them there are also those that do not fit this characteristic. Thus, as a result of the analysis of mycological studies conducted in Azerbaijan, the following species have been recorded as a result of the studies conducted by us: *Alternaria consortialis*, *Gliomastix murorum*, *Monilia pistaciae*, *Papularia roseum*, *Penicilium atrovenetum*, *P.clavigerum*, *P.duclauxii*, *P.palitans* and *P.viridicyclonium*. The macroscopic and microscopic features considered during the identification of these species, as well as information about the substrates they are isolated from, are annotated below:

1. *Alternaria consortialis* (Thüm.) J.W. Groves & S. Hughes.

During the research, the fungi was found in a sample taken from the Punuca L. plant (Greater Caucasus, Shabran region) that causes alternariosis (black spot) disease in the host plant, i.e. it is phytopathogenic.

The colony formed on AMJ has the ability to grow rapidly and is black in color (Fig. 1A). Aerial and substrate mycelia are clearly observed. The process of sporulation is intensive. Conidia are infusor-like in shape, with transverse and longitudinal septa (Fig. 1B).

2. *Gliomastix murorum* (Corda) S. Hughes.

The fungus was found in samples taken from the leaves of the *Amygdalis* L. plant (Greater Caucasus, Absheron) during research and was not found to cause any pathology in the plant from which it was isolated.

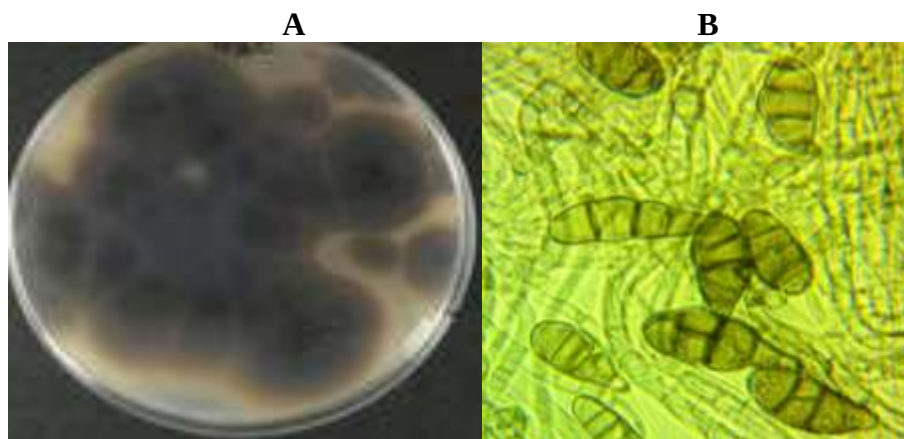


Figure 1. General view of a colony (A) and microscopic view of its conidia (B) formed by the fungus *Alternaria consortialis*

The colony formed by the fungus in the AMJ has a high growth rate, so that in 7 days the diameter of the colony it forms exceeds 7 cm. The color of the colony, although initially white, gradually darkens towards the center (Fig. 2A), which is due to the process of spore formation. Both aerial and substrate mycelia participate in colony formation. Conidia are formed in phialides 20-30 μm long (Fig. 2B), which can measure 2.5-5.5x2.0-4.4 μm .

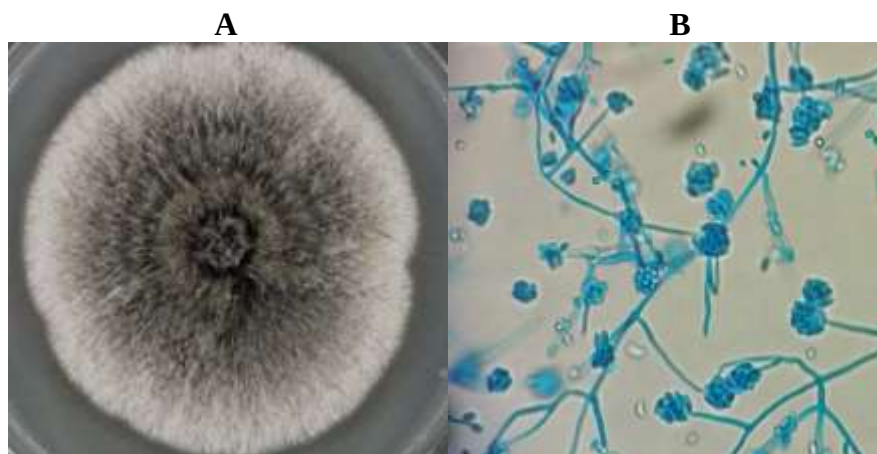


Figure 2. Microscopic view of the general(A) and mycelial structure(B) of the colony formed by the fungus *Gliomastix murorum*

3. *Monilia pistaciae* Zaprom.

This fungus species was found during research in samples taken from the fruits of the *Pistacia L. Plant*(fig. 3). The fungi causes fruit rot or moniliosis disease in the host plant. The visible form of the fungi is a dark brown spot on the fruit, which can range in size from 1 mm to 1-2 cm. Spore formation is also observed in the form of gray pads, which are also arranged in concentric circles. The spores are colorless, lemon-shaped, and in chains up to 15 μm long.



Figure 3. General view of the disease caused by *Monilia pistaciae* on almond plants

4. *Papularia roseum*

In the course of research, the fungi was found for the first time in samples taken from the *Olea L. plant* (Greater Caucasus, Absheron region). Later, the fungi was also found in a sample taken from the *Ziziphus Mill.* plant.

The colony formed by the fungi on agarized Chapek(ACh) medium is initially pale pink in color, but as sporulation intensifies, this color becomes dirty pink(fig.4A). The edges of the colony resemble a spider web, and the back of the colony also changes color, giving it a dirty pink color. In a colony formed from aerial and substrate mycelia, aerial mycelia are branched, septate, and colorless. Conidiophores released from aerial mycelia are simple, bottle-shaped, mostly solitary, sometimes in groups. The conidia are spherical (fig. 4b) and can be up to 2.5 μm in diameter. The conidia are initially light brown and later turn dark brown.

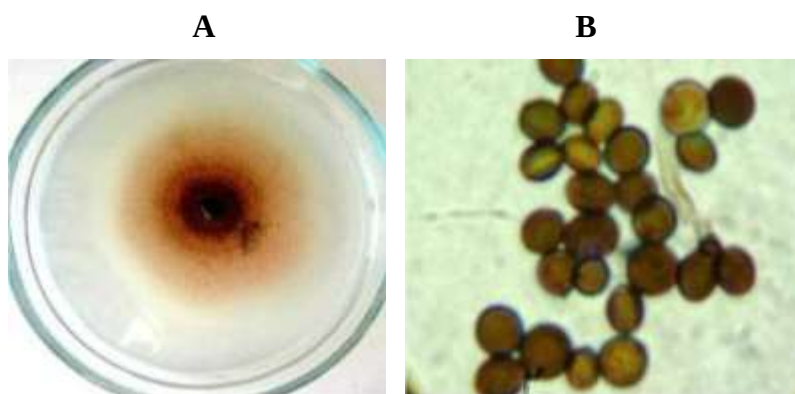


Figure 4. General (A) view of colony(7 days, ACh), and microscopic view of conidia (B) of fungi *Papularia roseum*

5. *Penicilium atrovenetum*

During the research, this fungi was found in samples taken from relatively clean soils (Kur-Araz lowland, relatively clean soil rich in plant remains), which is the first time that this fungus has been found in Azerbaijani conditions. The colony(fig. 5A) formed by the fungi in the AMJ has limited growth capacity, the surface is velvety, and the color is initially light bluish-green, but it soon turns gray (in 2-3 days), but after 10 days the colony darkens and takes on an almost black hue. Exudates in the form of small yellow droplets are also observed in the colony. The color of the back side of the colony, i.e. the reversum, changes, and in this case the observed color is yellowish-brown. During microscopic examination, the conidiophores of the fungi are 300 μm long and are mostly separated from the substrate mycelium(FIG.5B), the cysts are two-layered, and the conidia are spherical, the diameter of which can vary between 2.5-4.0 μm .

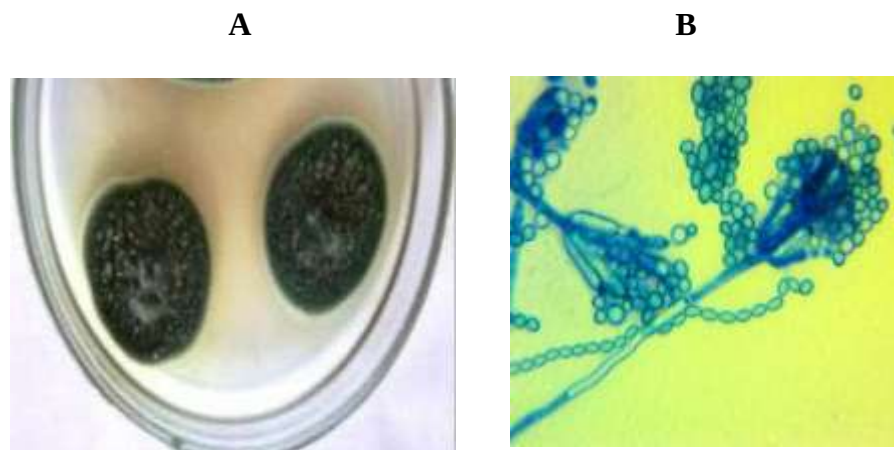


Figure 5. General (A) view of colony(7 days, ACh), and microscopic view of conidia (B) of fungi *Penicilium atrovenetum*

There is literature on the worldwide distribution of the fungus, and its species composition has been determined using modern molecular genetic methods[19], but its biological activity has not been extensively studied.

6. *P.clavigerum*

During the research, the fungi was found in samples taken from the soil used for cultivation (from the Greater Caucasus orchard), which was the first time this fungus was recorded in the country.

The characteristic balloon-shaped choremia colony formed by the fungus in AMJ is not growth-limited, but its growth is not considered fast either. Although the color of the colony is initially white, over time it becomes a dull yellow-green, and at the end of cultivation it becomes a grayish-dark olive(fig. 6A). The smell of fungi is strong. Conidiophore can reach several mm in length, i.e. they are long, have a smooth surface and 1-2 branches(fig. 6B). The metulae are in groups of 2-4 and measure 8-12x3.0-3.5 μm . The size of sterigmas is 7-

9x2.0-2.5 μm . The conidia are elliptic, with a smooth surface and are 3.0-4.0x2.2-3.0 μm .

7. *P. duclauxii*

The fungi was first time found in samples taken from lightly oil-contaminated soils (Greater Caucasus, Absheron Peninsula, Binagadi region). The colony formed by the fungi in the AMJ has limited growth capacity and consists mainly of substrate mycelia. The color of the colony varies from yellow-green to grayish olive green, which is related to the intensity of spore formation (fig. 7A). The color of the back of the colony also changes, and in this case, the color can range from yellow to orange-yellow. It does not have a strong moldy smell. Conidiophores are mainly separated from aerial mycelia, this phenomenon is sometimes observed in substrate mycelia, the latter conidiophores are relatively long (more than 1 mm) (fig. 7B). The cysts are typical and symmetrically bilayered. The metulae are in a ball and the sterigma are in a cluster of 3-6. Conidia are mostly spherical (up to 4 μm in diameter), which can sometimes form chains up to 70 μm long.

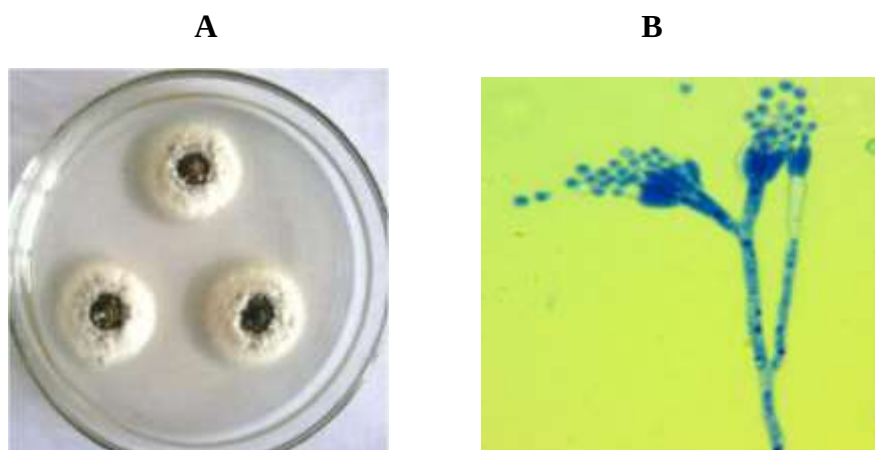


Figure 6. General (A), microscopic (B) view of conidiophores and conidia of a 7-day-old colony of *P. clavigerum* in AMJ.

8. *P. palitans*

During the research, the fungi was first found in samples taken from irrigated lands in the Kur-Araz lowland (Sabirabad district), which can be considered the first information confirming the spread of the fungus in the territory of the Republic of Azerbaijan. The growth capacity of the colony formed by the fungi on agarized Chapek medium is not limited, granular, white at the edges, greenish in the center, and later a yellow color is mixed into the grayish-green shades, and finally the color of the colony becomes grayish-olive (fig. 8A). The process of sporulation occurs intensively. The reverse color of the colony is initially unchanged, but eventually changes from yellowish to pale brown (fig. 8B). Microscopic examination revealed that the conidiophores of the fungi are 200 μm long and 4.0 μm wide, and they also have one or two branches (fig. 8C).

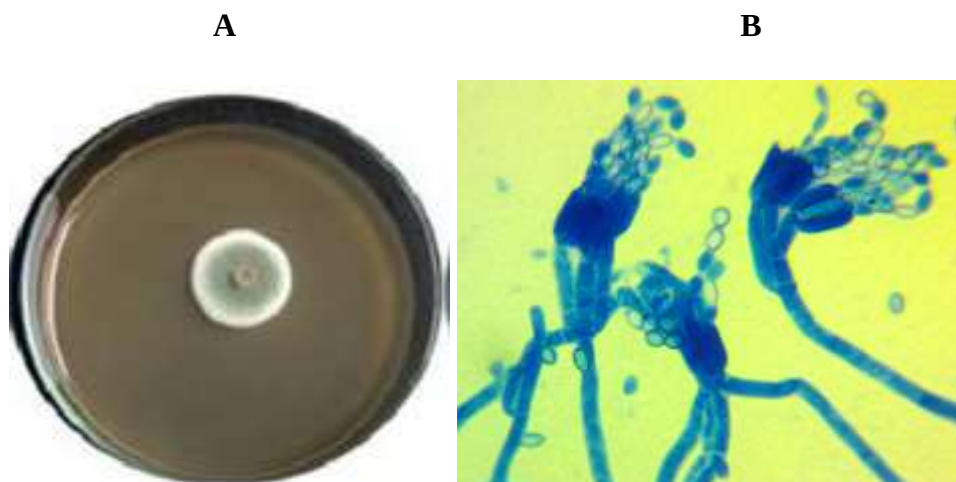


Figure 7. General (A), microscopic (B) view of conidiophores and conidia of a 7-day-old colony of *P. duclauxii* fungi in AMJ

The number of sterigma is maximum 7, and the conidia are of variable shape. Thus, while ellipiform conidia are first noticeable, later spherical conidia predominate. Conidia can also form chains.

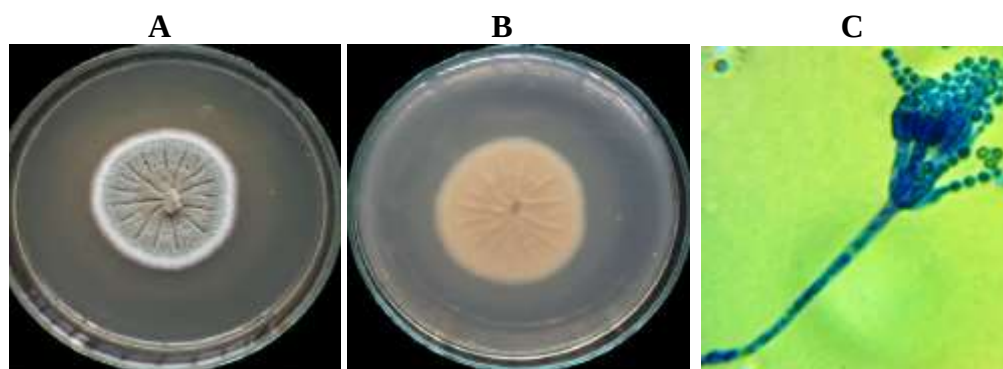


Figure 8. General images of the colony (A), reversum (B), and microscopic images of conidiophores and conidia (C) of the fungus *P. palitans*

Although this fungus, which is known to be widespread in the world, is not one of the widely studied species, there is literature information[15] about its synthesis of some mycotoxins.

9. *P. viridicyclonium*

The fungus was found in samples taken from relatively clean soils rich in plant remains from the Greater Caucasus (Absheron Peninsula) of the Republic of Azerbaijan.

The colony formed by the fungi in the AMJ has the ability to grow rapidly, the surface of the colony is smooth, has white edges, and intensive sporulation occurs(fig. 9A). The back side does not change color. Although limited, colorless

exudates with a strong musty odor are also found. Conidiophores are formed from substrate mycelium, their dimensions vary between $120\text{--}140 \times 3.5\text{--}5.5\text{ }\mu\text{m}$ (fig.9B). Conidia are spherical, with a diameter ranging between $2.5\text{--}3.8\text{ }\mu\text{m}$, with a smooth surface and in the form of chains.

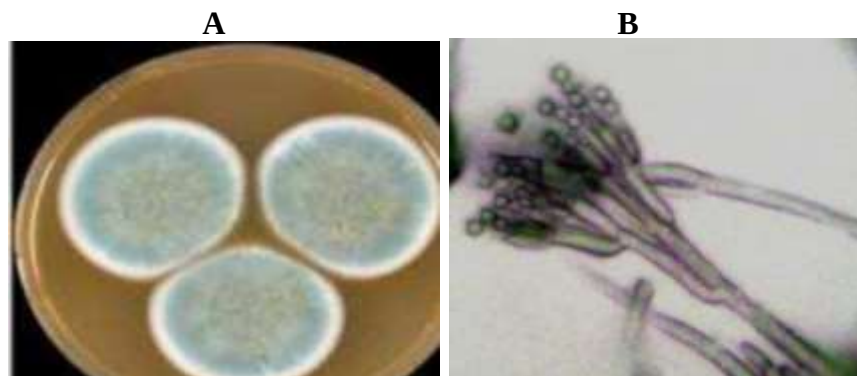


Figure 9. Microscopic image of the total, conidiophore and conidia(B) of a 7-day-old colony(A) of the fungi *P. viridicyclonium*

Thus, from the information provided above, it is clear that in the studies conducted in a short period of time (7 years), the distribution of 10 new fungi species in the Republic of Azerbaijan has been identified. This allows us to note that the study of the mycobiota specific to the nature of the Republic of Azerbaijan has not been comprehensively studied, but at the same time, the research conducted in this direction is relevant.

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