



Spatial Differentiation of Ascomycetes of the Malaisary Ridge (Kazakhstan)

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Abstract

Malaisary Mountains are located on the territory of Kazakhstan (southeastern regions) 120 km from the Almaty city. Mycobiota of the Malaisary ridge has 99 species belonging to ascomycetes. Ascomycete's fungi are represented by 11 orders from 3 classes. The highest number of orders (5) is characteristic of the class *Dothideomycetes*. The largest genera are *Mycosphaerella* (7 species), *Pleospora* (7 species) and *Ramularia* (5 species). The most other genera contain 1-2 species. The class of *Leotiomycetes* is represented by 2 orders, 2 families with 8 genera. The largest genera are *Golovinomyces* (6 species), *Erysiphe* (6 species) and *Podosphaera* (5 species), related to order *Erysiphales*. The greatest number of species of ascomycetes is noted in the steppe belt of the Malaisary ridge: on the northern macroslope 35 species from 23 genera, on the southern macroslope 46 species from 26 genera. A large number of species on the southern slope is registered due to the fact that it is rocky and steep with deep gorges. In the steppe belt of the Malaisary ridge only 12 species of ascomycetes are common between the northern and southern macroslopes, and the vast majority of them belong to powdery mildew fungi (8 species). The northern macroslope is characterized by a diversity of representatives of the genera *Mycosphaerella* and *Selenophoma*, while the southern macroslope-by representatives of the genus *Ramularia*.

Keywords: Ascomycete; Fungus; Malaisary Ridge; Powdery Mildew; Species

Introduction

The small flattened mountains of Malaisary are located on the territory of Kazakhstan 120km from the Almaty city and are the most western spur of the Dzungarian Alatau. The length of the ridge is approximately 80km, the width-10km and the absolute height-not more than 1500m above sea level. In the west, the Malaisary mountains about the Ili river, in the southeast they pass into the Chulak mountains (Chulaktau, Sholak), to the south, the low-mountainous relief of Malaisary smoothly passes into the inclined plains of the Karoy plateau (860-920m above sea level).

The relief of the Malaisary Mountains is hilly, the north side (macroslope) is gentler, and the south side (macroslope) is rocky with deep gorges. Some spurs stand out from the main ridge: Kulanbasy (Kumbasy), Arkharly and Tasmurun mountains. The river network is extremely poorly developed. All rivers dry up, turning into dry channels or stony watercourse. There are several springs and artesian wells that are used for the needs of the population. The climate in the described territory is sharply continental with significant amplitude of temperature fluctuations. The average annual temperature is about +4.5°C. The coldest month is January with an average temperature of -7°C, the hottest month is

July with an average temperature of +30°C. The snow cover is shallow (10-20cm) and unstable, lasts for 50 days. The total precipitation is about 150 mm per year. Almost 60 days a year drought lasts here [1].

Desert climate affects the vegetation of the Malaisary ridge. Altitudinal belts begin with desert foothills, which are replaced by semi-desert and steppe zones. There is no forest belt, only along the gorges and northern slopes there are shrubs-hens, wild cherries, spirea and rose hips. Despite the scarcity of mountain vegetation, a large number of endemic and relict species are found in the flora.

From a mycological point of view, the Malaisary ridge has been practically unexplored for a long time. Some samples were collected through the ridge in 2010, 2012, 2013. During the implementation of the project "The current state of species diversity of mycobiota and algoflora in the desert lowlands of the southeast of Kazakhstan and their rational use" (2014-2017), the northern and southern macroslopes of the Malaisary Ridge, Arkharly and Kulanbasy mountains were examined by the staff of the Laboratory of Mycology and Algology of the Institute of Botany and Phytointroduction.

The Malaisary ridge is characterized with the Dzhungar-Northern-Tyanshan type of zonation. Two zones are clearly distinguished: foothill deserts (with a predominance of wormwood) and steppes (with the dominance of turfgrains). Vertically the length of each zone is approximately 300-400m: piedmont deserts-600-900m, steppes-900-1300m. Mesophytic shrubs (meadowsweet, hens, and dogrose) are characteristic of the northern slopes and hollows. Ephemers and ephemeroids play a significant role [2].

Research area belongs to the desert lowlands, which are distinguished by a variegated and diverse vegetation cover and a significant representation of rare plants listed in the Red Book of Kazakhstan [3]. Poor knowledge of the mycobiota of the desert lowlands served as the basis for their mycological examination. The purpose of this article is to study the spatial differentiation of the biota of ascomycetes of the Malaisary ridge.

Materials and Methods

The study was conducted in the Malaisary ridge (Figures 1 & 2) (southeastern regions of Kazakhstan) for several years (2004, 2005, 2013-2017).

Different parts of plants with symptoms of fungal diseases and various substrates with visible fungal development were collected during field trips. A Canon 600E camera was used for photographing of fungi.

For light microscopy, small fragments of samples were stripped off the substrates, placed in a drop of distilled water on a microscope slide without any staining [4], examined and photographed using a photomicroscope Polyvar with Nomarski interference contrast optics. Measurements of different fungal structure were made. Specimens were identified with the literature on ascomycetes [5-15].



Figure 1: Map of Kazakhstan showing the locality of Malaisary ridge (asterisk).



Figure 2: Malaisary Mountains.

Dried specimens are stored in the herbarium of the Institute of Botany and Phytointroduction, Almaty, Kazakhstan (AA).

The systematics of the taxa is in accordance with *Ainsworth and Bisby's* dictionary of the fungi and they are listed in alphabetical order [16]. The names of the host plants are given in accordance with the on-line identifier of plants [17], the names of fungal taxa -in accordance with the Index Fungorum database [18].

Results

Recently, the mycobiota of the Malaisary ridge has 99 species belonging to ascomycetes (Table 1). Ascomycete's fungi are represented by 11 orders from 3 classes. Three genera (*Fumago*, *Hormiscium*, and *Torula*) have an unclear

systematic position. The highest number of orders is characteristic of the class *Dothideomycetes*. The largest genera are *Mycosphaerella* (7 species), *Pleospora* (7 species) and *Ramularia* (5 species). The most other genera contain 1-2 species. Two genera of *Dothideomycetes* (*Camarosporium* and *Placosphaeria*) have an unclear systematic position.

Class	Order	Family	Genus	Number of Species	
<i>Insertae sedis</i>			<i>Fumago</i>	1	
			<i>Hormiscium</i>	1	
			<i>Torula</i>	2	
<i>Dothideomycetes</i>	<i>Botryosphaerales</i>	<i>Botryosphaeriaceae</i>	<i>Diplodia</i>	1	
			<i>Microdiplodia</i>	1	
	<i>Capnodiales</i>	<i>Davidiellaceae</i>	<i>Cladosporium</i>	3	
			<i>Mycosphaerellaceae</i>	<i>Mycosphaerella</i>	7
			<i>Ramularia</i>	5	
			<i>Septoria</i>	4	
	<i>Dothideales</i>	<i>Dothioraceae</i>	<i>Discosphaerina</i>	1	
			<i>Kabatia</i>	1	
			<i>Selenophoma</i>	5	
	<i>Hysteriales</i>	<i>Hysteriaceae</i>	<i>Graphyllum</i>	1	
	<i>Pleosporales</i>	<i>Cucurbitariaceae</i>	<i>Cucurbitaria</i>	2	
			<i>Didymellaceae</i>	<i>Phoma</i>	2
			<i>Leptosphaeriaceae</i>	<i>Leptosphaeria</i>	1
		<i>Lophiostomataceae</i>	<i>Lophiostoma</i>	2	
		<i>Melanommataceae</i>	<i>Ohleria</i>	1	
		<i>Phaeosphaeriaceae</i>	<i>Phaeosphaeria</i>	2	
			<i>Sphaerellopsis</i>	1	
			<i>Ampelomyces</i>	1	
			<i>Pleomassariaceae</i>	<i>Pleomassaria</i>	1
		<i>Pleosporaceae</i>	<i>Alternaria</i>	2	
			<i>Macrosporium</i>	1	
			<i>Pleospora</i>	7	
			<i>Stemphyllum</i>	2	
<i>Insertae sedis</i>			<i>Camarosporium</i>	2	
			<i>Placosphaeria</i>	1	
<i>Leotiomycetes</i>	<i>Erysiphales</i>	<i>Erysiphaceae</i>	<i>Blumeria</i>	1	
			<i>Erysiphe</i>	6	
			<i>Golovinomyces</i>	6	
			<i>Leveillula</i>	1	
			<i>Neoerysiphe</i>	2	
			<i>Podosphaera</i>	5	
	<i>Helotiales</i>	<i>Dermateaceae</i>	<i>Pseudopeziza</i>	2	
	<i>Insertae sedis</i>			<i>Cylindrosporium</i>	2

Peizomycetes	Insertae sedis		<i>Pseudodichomera</i>	1
			<i>Schwarzmannia</i>	1
Sordariomycetes	<i>Diaporthales</i>	<i>Pseudovalsaceae</i>	<i>Coryneum</i>	1
		<i>Valsaceae</i>	<i>Leucostoma</i>	1
	<i>Hypocreales</i>	<i>Clavicipitaceae</i>	<i>Claviceps</i>	1
	<i>Phyllachorales</i>	<i>Phyllachoraceae</i>	<i>Polystigma</i>	1
	<i>Xylariales</i>	<i>Xylariaceae</i>	<i>Poronia</i>	1
			<i>Rosellinia</i>	1
	Insertae sedis		<i>Stegosporium</i>	2
			<i>Strickeria</i>	3
Total	11	20	46	99

Table 1: Taxonomic structure of the biota of ascomycetes of the Malaisary ridge.

The class of *Leotiomyces* is represented by 2 orders, 2 families with 8 genera and genus *Cylindrosporium* with unclear systematic position. The largest genera are *Golovinomyces* (6 species), *Erysiphe* (6 species) and *Podosphaera* (5 species), related to order *Erysiphales*. *Helotiales* order has two species of the genus *Pseudopeziza* from the family *Dermateaceae*.

The *Peizomycetes* class is represented by two species from genera *Pseudodichomera* and *Schwarzmannia* with an unclear systematic position.

Genera of the *Sordariomycetes* class contain 1-2 species, with the exception of 3 species of the genus *Strickeria* with an unclear systematic position.

There are only 4 species of ascomycetous fungi from 4 genera in the foothill plain of the northern macroslope (Sands of Zhineshkekum) (Table 2). All these species are found both in the foothill plain and in the steppe belt of the Malaisary ridge.

Options	The Main Ridge of the Malaisary					Arkharly	Kulanbasy
	Northern Macroslope			Southern Macroslope			
	Foothill Plain	The Steppe Belt	The shrub belt	The steppe belt	The shrub belt		
Number of species	4	35	6	46	10	32	7
Number of genera	4	23	6	26	10	23	6
Ratio of species and genera	1	1.5	1	1.8	1	1.4	1.2

Table 2: Characteristics of biota of ascomycetes of the Malaisary ridge.

The greatest number of species of ascomycetes is noted in the steppe belt of the Malaisary ridge: on the northern macroslope 35 species from 23 genera, on the southern macroslope 46 species from 26 genera (Table 2). A large number of species on the southern slope is registered due to the fact that it is rocky and steep with deep gorges. Therefore, the various ecological conditions are characteristic of the southern macroslope. It is interesting to note that in the steppe belt of the Malaisary ridge only 12 species of ascomycetes are common between the northern and southern macroslopes, and the vast majority of them (8 species) belongs to powdery mildew fungi. The most commonly observed species: *Blumeria graminis* (DC) Speer,

Erysiphe cruciferarum (Opiz) L Junell, and *Erysiphe polygoni* DC (Figure 3), *Golovinomyces cynoglossi* (Wallr) VP Heluta (Figure 4), *Leveillula taurica* (Lev) G Arnaud (Figure 5) and *Neoerysiphe galeopsidis* (DC) U Braun (Figure 6). The northern macro slope is characterized by a diversity of representatives of the genera *Mycosphaerella* and *Selenophoma*, while the southern macroslope-by representatives of the genus *Ramularia*.

The shrub belt occupies a small area on the territory of the Malaisary ridge and is characterized by a small number of species of ascomycetous fungi: on the northern macroslope 6 species from 6 genera, on the southern macroslope 10

species from 10 genera (Table 2). Common to the northern and southern macro slopes are 3 species of ascomycetes.



Figure 3: *Erysiphe polygoni* DC on *Polygonum aviculare* L.



Figure 4: *Golovinomyces cynoglossi* (Wallr) VP Heluta on *Nonea caspica* (Willd) G Don.



Figure 5: *Leveillula taurica* (Lév) G Arnaud on *Lagochilus platycalyx* Schrenk.



Figure 6: *Neerysiphe galeopsidis* (DC) U Braun on *Phlomooides iliensis* (Regel) Adylov, Kamelin & Makhm.

In the strongly dissected Arkharly Mountains with various environmental conditions, 32 species of fungi from 23 genera are found, while in the smoothed low mountains of Kulanbasy there are only 7 species from 6 genera (Table 2).

Ascomycetous fungi attack 106 species of vascular plants on the territory of the Malaisary ridge.

Discussion

The Chulak and Altyn-Emel ranges are the closest to Malaisary. However, the species composition of the mycobiota Altyn-Emel and Chulak totals 56 and 20 species, respectively (Table 3).

Species of 11 genera of ascomycete fungi are found in all three ranges and the number of representatives of the genera *Blumeria*, *Camarosporium*, *Fumago*, *Neerysiphe* and *Rosellinia* is approximately the same. The genera *Erysiphe*, *Golovinomyces*, and *Pleospora* are represented by a large number of species in Malaisary, and the genus *Strickeria* is represented in Altyn-Emel. Species of 10 genera are common for the mycobiota of the Malaisary and Altyn-Emel ranges, while only 1 genus (*Septoria*) is found in both Malaisary and Chulak. Species of 24 genera of ascomycetous fungi were found only in Malaisary, 9 genera only in Altyn-Emel. It should be noted that a greater number of species of fungi from the genera *Camarosporium*, *Cytospora* and *Strickeria*, recorded on tree-shrubbery vegetation, are characteristic of the Altyn-Emel ridge (up to 2000 m above sea level), which is characterized by sufficient humidity. On the other hand, representatives of two mycophilic genera *Ampelomyces* and *Sphaerellopsis* were found only in Malaisary.

Genera	Number of Species in the		
	Malaisary Ridge	Chulak Mountains [19]	Altyn-Emel [20]
<i>Alternaria</i>	2	-	2
<i>Ampelomyces</i>	1	-	-
<i>Blumeria</i>	1	1	1
<i>Camarosporium</i>	2	2	3
<i>Chaetoplea</i>	-	-	1
<i>Cladosporium</i>	3	-	1
<i>Claviceps</i>	1	-	-
<i>Coniochaeta</i>	-	-	1
<i>Coniothyrium</i>	-	-	1
<i>Coryneum</i>	1	-	-
<i>Cucurbitaria</i>	2	-	2
<i>Cylindrosporium</i>	2	-	-
<i>Cytospora</i>	-	1	7
<i>Diplodia</i>	1	-	-
<i>Discosphaerina</i>	1	-	-
<i>Erysiphe</i>	6	1	2
<i>Fumago</i>	1	1	1
<i>Golovinomyces</i>	6	3	1
<i>Graphyllum</i>	1	-	-
<i>Hendersonia</i>	-	-	1
<i>Hormiscium</i>	1	-	1
<i>Kabatia</i>	1	-	-
<i>Leptosphaeria</i>	1	-	-
<i>Leucostoma</i>	1	-	1
<i>Leveillula</i>	1	-	1
<i>Lophiostoma</i>	2	-	1
<i>Macrosporium</i>	1	-	-
<i>Microdiplodia</i>	1	-	-
<i>Mycosphaerella</i>	7	-	-
<i>Myxofusicoccum</i>	-	-	1
<i>Nectria</i>	-	-	1
<i>Neoerysiphe</i>	2	2	1
<i>Ohleria</i>	1	-	-
<i>Phaeoseptoria</i>	-	-	1
<i>Phaeosphaeria</i>	2	-	-
<i>Phoma</i>	2	-	2
<i>Phyllachora</i>	-	-	1
<i>Phyllactinia</i>	-	-	1
<i>Placosphaeria</i>	1	-	-

<i>Pleomassaria</i>	1	-	1
<i>Pleospora</i>	7	2	1
<i>Podosphaera</i>	5	1	5
<i>Polystigma</i>	1	-	-
<i>Poronia</i>	1	-	-
<i>Pseudodichomera</i>	1	-	-
<i>Pseudopeziza</i>	2	-	-
<i>Ramularia</i>	5	-	-
<i>Rosellinia</i>	1	1	1
<i>Schwarzmannia</i>	1	-	-
<i>Scirrhia</i>	-	-	1
<i>Selenophoma</i>	5	-	3
<i>Septoria</i>	4	1	-
<i>Sphaerellopsis</i>	1	-	-
<i>Stegosporium</i>	2	-	-
<i>Stemphylium</i>	2	-	-
<i>Strickeria</i>	3	3	6
<i>Torula</i>	2	1	2
Total	99	20	56

Table 3: Number of species of ascomycetes in the Malaisary ridge, Altyn-Emel and Chulak mountains.

Conclusion

Mycobiota of the Malaisary ridge has 99 species belonging to ascomycetes. The largest genera are *Mycosphaerella* (7 species), *Pleospora* (7 species), *Golovinomyces* (6 species), *Erysiphe* (6 species), *Podosphaera* (5 species), and *Ramularia* (5 species). The most other genera contain 1-2 species. The greatest number of species of ascomycetes is noted in the steppe belt of the Malaisary ridge: on the northern macroslope 35 species from 23 genera, on the southern macroslope 46 species from 26 genera. The northern macroslope is characterized by a diversity of representatives of the genera *Mycosphaerella* and *Selenophoma*, while the southern macroslope-by representatives of the genus *Ramularia*.

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