

## Analyses of Taxonomy and Distribution of Fungi Species in Woody-Bush Plantations of the Pavlodar Region, Kazakhstan

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### Abstract

In this work the results of a taxonomic analysis of the plant pathogenic species of fungi distributed in woody-bush green plantations of the Pavlodar region, Kazakhstan, are presented. The study was carried out in some cities, such as Pavlodar, Aksu and Ekibastuz, between 2002 and 2006, and completed comparative analysis on the degree of plant damage caused by diseases of pathogenic fungi. Totally 60 species pathogenic fungi were revealed from 21 species of trees belonging to 12 genera and 15 species of bushes from 9 genera. Ten species of them recorded as new host plants for fungi in Kazakhstan.

**Key words:** plant pathogenic fungus, green plantation, Kazakhstan

This research was carried out in the cities as Pavlodar, Aksu and Ekibastuz. Sixty species of pathogenic fungi were revealed from 21 species of trees belonging to 12 genera and 15 species of bushes from 9 genera. Ten species were recorded as a new host plant for fungi in Kazakhstan, namely: *Caragana arborescens*, *Sambucus racemosa*, *Ulmus pinnatoromosa*, *Syringa* sp., *Grossularia* sp., *Viburnum opulus*, *Salix acutifolia*, *Ribes spicatum*, *Elaeagnus angustifolia*, *Fraxinus excelsior*, *Malus domestica*, *Populus nigra*, *Crataegus sanguinea*, *Salix alba*, *Betula pendula*, *Rosa* sp., *Acer negundo* and *Ribes* sp.

Among the collected fungi, five unknown species were found: *Microsphaera* sp. growing on *Populus nigra*, *Vitis* sp. and *Uncinula* sp. on *Ribes nigra*, and *Elaeagnus angustifolia*, and *Gloeosporium* sp. on *Populus alba*. The morphological measurements of these fungi are not available in the identification keys (e.g. Saccardo, 1832-1931), and moreover, none of them were identical with the type specimens kept in the Institute of Botany and Plant Introduction, Ministry of Science, Kazakhstan.

The identified 60 species of fungi belong to six orders, but 36 of them are representatives of only one order, Erysiphales, and these species are spread in seven different orders. Among the genera of the latter order, *Microsphaera* consists of 11 species, *Phyllactinea* – 10 species, *Uncinula* – 6 species, *Podosphaera* and *Leveillula* each have 3 species. The other order, Uredinales is

composed of 13 species belonging to 4 genera, such as *Melampsora* with 6 species, *Phragmidium* (3 spp.), *Perdermim* (3 spp.) and *Gymnoconia* (1 sp.).

A third order, Sphaeropsidales consists of 8 species from 3 genera: *Phyllosticta* (4 spp.), *Cytospora* (3 spp.) and *Cenangium* (1 sp.). Twelve species of fungi are members of the order Melanconiales, and they belong to three genera: *Cylindrosporium* (5 spp.), *Gloeosporium* (5 spp.) and *Marssonina* (2 spp.). The remaining orders of fungi only have one species in each.

It is noticeable that some of the revealed species of fungi feed and were dispersed on several species of trees, but other fungi species were found only on a certain species of tree. For example, *Leveillula taurica* and *L. taurica* f. *caraganae* were found on *Elaeagnus angustifolia* and *Caragana arborescens*. The fungi, such as *Microsphaera betulae*, *M. penicillata*, *M. sambucus*, *M. syringae*, *M. grossularia*, *M. hedwigii*, *M. berberidis*, *Microsphaera* sp. were found in *Betula tianschanica*, *Populus alba*, *Ulmus pinnatoromosa*, *Sambucus racemosa*, *Syringa* sp., *Vitis vimifera*, *Grossularia* sp., *Viburnum opulus* and *Berberis heteropoda*.

Fungi of the genus *Phyllactinia*, such as *P. suffulta salicis*, *P. suffulta populi*, *P. suffulta betulae*, *P. suffulta mali*, *P. suffulta ribesii*, *P. suffulta syringae*, *P. suffulta elaeagni* and *P. suffulta fraxini* feed on *Salix* sp., *Populus nigra*, *Betula tianschanica*, *Malus domestica*,

*Ribes spicatum*, *Syringa vulgaris*, *Elaeagnus angustifolia*, *Fraxinus excelsior*.

Two species of fungi of the genus *Sphaerotheca*, *S. mors* and *S. pannosa*, are known to feed on *Grossularia reclinata* and *Rosa spinosissima*. Fungi of the species *Uncinula salicis populorum*, *U. clandestine*, *U. aceris* and *Uncinula* sp. were found in *Populus nigra*, *Ribes nigra*, *Elaeagnus angustifolia*, *Ulmus pinnatoromosa* and *Acer platanoides*.

So, the number and composition of fungi species in different species of trees or shrubs are

variable. The main findings of the occurrence of fungi on plant species are given in Tables 1 and 2.

Among the revealed species of fungi, only some are widely distributed in the studied areas. For instance, the genus *Microsphaera* is represented in Pavlodar city by 8 species, and in Aksu and Ekibastuz cities by 1 and 2 species, respectively. The genus *Phyllactinia* has 4 species in Pavlodar, and 2 and 4 species in Aksu and Ekibastuz cities, respectively. Both two species of the genus *Uncinula* are found in all three cities,

Table 1. Species of the pathogenic fungi and their occurrences in different species trees of Pavlodar city

Species of fungi	Tree species														
	<i>Elaeagnus angustifolia</i>	<i>Betula tianschanica</i>	<i>Populus nigra</i>	<i>Ulmus pinnato-romosa</i>	<i>Salix</i> sp	<i>Grossularia reclinata</i>	<i>Malus domestica</i>	<i>Salix alba</i>	<i>Populus pyramidalis</i>	<i>Pinus sylvestris</i>	<i>Acer negundo</i>	<i>Betula pendula</i>	<i>Populus tremula</i>	<i>Grossularia reclinata</i>	<i>Populus alba</i>
<i>Leveillula taurica elaeagni</i>	1														
<i>Microsphaera betulae</i>		1													
<i>Microsphaera</i> sp															1
<i>Microsphaera penicillata</i>				1											
<i>Phyllactinia suffulta salicis</i>					2										
<i>Phyllactinia suffulta populi</i>			1												
<i>Phyllactinia suffulta betulae</i>		1													
<i>Phyllactinia suffulta mali</i>							2							1	
<i>Sphaerotheca mors</i>						2									
<i>Uncinula salicis. populorum</i>			3												
<i>Melampsora magnusiana</i>			3												
<i>Melampsora salicina</i>								2							
<i>Melampsora populina</i>									3						
<i>Peridermim pini</i>										3					
<i>Cytospora salicis</i>											3				
<i>Cytospora pseudoplatani</i>												1			
<i>Phyllosticta betulicola</i>													1		
<i>Cenangium abietis</i>												1			
<i>Cylindrosporium pruinosum</i>														1	
<i>Cylindrosporium ulmi</i>				1											
<i>Cylindrosporium pseudoplatani</i>													1		
<i>Gloeosporium salicis</i>															2
<i>Gloeosporium</i> sp															
<i>Gloeosporium betulinum</i>														1	
<i>Nectria galligena</i>			2												
<i>Lophodermium pinastri</i>															3

Explanation: The numbers given in the table are indicating the degree of plant defeat: 1 – little, 2 – middle, 3 – high. It is also applied for the next tables.

Table 2. Species of the pathogenic fungi and their occurrences in different species bushes of Pavlodar city

Species of fungi	Species of bushes										
	<i>Sambucus racemosa</i>	<i>Syringa</i> sp.	<i>Vitis vinifera</i>	<i>Grossularia</i> sp.	<i>Viburnum opulus</i>	<i>Ribes nigra</i>	<i>Sorbus tianschanica</i>	<i>Rosa</i> sp.	<i>Rubus idaeus</i>	<i>Ribes meyeri</i>	<i>Ribes</i> sp.
<i>Microsphaera sambucus</i>	3										
<i>Microsphaera syringae</i>		3									
<i>Microsphaera</i> sp.			1								
<i>Microsphaera grossularia</i>				1							
<i>Microsphaera Hedwigii</i>					1						
<i>Uncinula</i> sp.						1					
<i>Podosphaera oxyacanthae</i>							1				
<i>Phragmidium discoflorum</i>								3			
<i>Phragmidium rubiidae</i>									2		
<i>Gymnoconia Peckiana</i>									1		
<i>Marssonina ribicola</i>										1	
<i>Gloeosporium ribis</i>											1

Table 3. Species of the pathogenic fungi and their occurrences in different tree and bush species of Aksu city

Species of fungi	Tree species								
	<i>Elaeagnus angustifolia</i>	<i>Ulmus pinnatoromosa</i>	<i>Salix alba</i>	<i>Populus pyramidalis</i>	<i>Populus alba</i>	<i>Salix</i> sp.	<i>Acer tataricum</i>	<i>Pinus sylvestris</i>	
<i>Leveillula taurica elaeagni</i>	1								
<i>Uncinula</i> sp.	1								
<i>Uncinula clandestine</i>		1							
<i>Melampsora salicina</i>			2						
<i>Melampsora populina</i>				3					
<i>Marssonina populi</i>					1				
<i>Cylindrosporium salicinum</i>						1			
<i>Gloeosporium acericolum</i>							1		
<i>Peridermium pini</i>								3	
Species of fungi	Species of bushes								
	<i>Syringa</i> sp.	<i>Ribes spicatum</i>	<i>Syringa vulgaris</i>	<i>Rosa spinosissima</i>	<i>Padus racemosa</i>	<i>Rosa</i> sp.	<i>Rosa oxyacantha</i>		
<i>Microsphaera syringae</i>	1								
<i>Phyllactinia suffulta ribesii</i>		3							
<i>Phyllactinia suffulta syringae</i>			3						
<i>Sphaerotheca pannosa</i>				1					
<i>Podosphaera tridactyla</i>					2				
<i>Phragmidium discoflorum</i>						3			
<i>Phyllosticta rosarum</i>							1		

Table 4. Species of the pathogenic fungi and their occurrences in different tree and bush species of Ekibastuz city

Species of fungi	Tree species										
	<i>Betula tianschanica</i>	<i>Ulmus pinnatoromosa</i>	<i>Elaeagnus angustifolia</i>	<i>Fraxinus excelsior</i>	<i>Acer platanoides</i>	<i>Populus nigra</i>	<i>Betula pendula</i>	<i>Pinus sylvestris</i>	<i>Salix alba</i>	<i>Acer negundo</i>	<i>Betula sp.</i>
<i>Phyllactinia suffulta betulae</i>	1										
<i>Phyllactinia suffulta mali</i>		2									
<i>Phyllactinia suffulta elaeagni</i>			1								
<i>Phyllactinia suffulta fraxini</i>				1							
<i>Uncinula aceris</i>					3						
<i>Uncinula salicis populorum</i>						3					
<i>Melampsorium betulae</i>							3				
<i>Peridermium pini</i>								3			
<i>Cytospora salicis</i>									3		
<i>Phyllosticta populina</i>						1					
<i>Phyllosticta platanoidis</i>										1	
<i>Cylindrosporium betulae</i>											2
<i>Nectria galligena</i>						2					
Species of fungi	Species of bushes										
	<i>Caragana arborescens</i>	<i>Syringa sp.</i>	<i>Crataegus sanguinea</i>	<i>Berberis heteropoda</i>							
<i>Leveillula taurica f. caraganae</i>	3										
<i>Microsphaera berberidis</i>				1							
<i>Microsphaera syringae</i>		3									
<i>Trichocladia caraganae</i>	3										
<i>Podosphaera oxyacanthae</i>			2								

while the genus *Melampsora* has 1 species in both Pavlodar and Ekibastuz cities and 2 species in Aksu city. Three species of fungi from the genus *Cylindrosporium* are found in Pavlodar, and 1 species in each of the two other cities. The city Ekibastuz had two species of *Phyllosticta*, but the other cities encompass only one species of this genus.

During the study we found that the fungi species in a given species of tree or shrubs might be different. For example, in Pavlodar city two species of fungi, *Microsphaera betulae* and *Phyllactinia suffulta* are found on *Betula tianschanica*. In the meantime on *Populus nigra* we found 4 species of fungi, such as *Phyllactinia suffulta populi*, *Uncinula salicis populorum*, *Melampsora magnusiana* and *Nectria galligena*, and the comparisons can be seen in Tables 1, 2, 3 and 4.

Among the bushes, *Rubus idaeus* is affected by *Phragmidium rubiidae* and *Gymnoconia peckiana*, but on the other species of bushes we found only a single fungus species.

In the Tables 1 to 4 we give data on occurrences of fungi on different trees and bushes in various cities.

In Aksu city two species of fungi, *Leveillula*

*taurica elaeagni* and *Uncinula sp.*, are found on *Elaeagnus angustifolia*; all other species of trees and shrubs contain only one species in each.

As for the Ekibastuz city, on *Populus nigra* we found 3 species of pathogenic fungi: *Uncinula salicis populorum*, *Phyllosticta populina* and *Nectria galligena*. Among shrubs growing in this city only *Caragana arborescens* was affected by two species of pathogenic fungi *Leveillula taurica f. caraganae* and *Trichocladia caraganae* (Table 4).

In the Table 5 we present the degree to which trees are affected (degree of defeat) by plant pathogenic fungi using 3 points (Semakova and Sokolova, 2002).

According to this estimation, the most affected species of green plantations in the three studied cities are *Populus nigra*, *Salix alba*, *Pinus sylvestris* and *Caragana arborescens*. However, species such as *Fraxinus excelsior*, *Malus domestica* and *Crataegus sanguinea* have been relatively little affected by pathogenic fungi.

## References

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Table 5. Defeat of plants due to effect of pathogenic fungi in various cities of Kazakhstan

Plant species	Fungus species	Degree of defeat (summarized)	Pavlodar city	Ekibastuz city	Aksu city
<i>Betula tianschanica</i>	1. <i>Microsphaera betulae</i>	1			
	2. <i>Phyllactinia suffulta betulae</i>	1	1	1	
<i>Populus nigra</i>	1. <i>Phyllactinia suffulta populi</i>	1	1		
	2. <i>Uncinula salicis populorum</i>	3			
	3. <i>Melampsora magnusiana</i>		3	3	
	4. <i>Nectria galligena</i>	3	3	3	
<i>Ulmus pinnatoromosa</i>	1. <i>Microsphaera penicillata</i>	1	1		
	2. <i>Cylindrosporium ulmi</i>	1	1		
<i>Salix alba</i>	1. <i>Melampsora salicina</i>	2	2		
	2. <i>Cytospora salicis</i>	3	3		2
	3. <i>Gloeosporium salicis</i>	2	2	3	
<i>Pinus sylvestris</i>	1. <i>Peridermium pini</i>	3	3		
	2. <i>Cenangium abietis</i>	1	1	3	3
	3. <i>Lophodermium pinastri</i>	3	3		
<i>Acer negundo</i>	1. <i>Cytospora pseudoplatani</i>	1	1		
	2. <i>Cylindrosporium pseudoplatani</i>				
	3. <i>Phyllosticta platanoidis</i>	1	1	1	
<i>Betula pendula</i>	1. <i>Phyllosticta betulicola</i>	1			
	2. <i>Gloeosporium betulinum</i>		2		
<i>Populus alba</i>	1. <i>Microsphaera sp</i>	1			
	2. <i>Gloeosporium sp</i>	1	2		
<i>Rubus idaeus</i>	1. <i>Phragmidium rubiidae</i>	1			
	2. <i>Gymnoconia Peckiana</i>	1	2		
<i>Populus nigra</i>	1. <i>Uncinula salicis populorum</i>	3			
	2. <i>Phyllosticta populina</i>	1		3	
	3. <i>Nectria galligena</i>	2			
<i>Caragana arborescens</i>	1. <i>Leveillula taurica f. caraganae</i>	3			
	2. <i>Trichocladia caraganae</i>	3		2	
<i>Elaeagnus angustifolia</i>	1. <i>Leveillula taurica elaeagni</i>	1			2
	2. <i>Uncinula sp.</i>	1			

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### Хураангуй

Энэхүү өгүүлэлд Казахстан улсын Павлодар хот орчмын нутгийн таримал мод болон бут, сөөглөг ургамал дээр тохиолдох өвчин үүсгэгч мөөгний ангилал зүйн анализыг авч үзэв.

Судалгааг 2002-2006 онуудад Павлодар, Аксу, Экибастуз зэрэг хотуудад явуулсан бөгөөд өвчин үүсгэгч мөөгөөр халдварлаж өвчилсэн ургамлын хөнөөгдлийн зэргийг хот тус бүрээр харьцуулж гаргав. Нийт 12 төрлийн 21 зүйлийн мод, 9 төрлийн 15 зүйлийн сөөглөг ургамлаас 60 зүйлийн өвчин үүсгэгч мөөгийг илрүүлэв. Тус улсад 10 зүйлийн ургамал өвчин үүсгэгч мөөгний шинэ эзэн болох нь тогтоогдов.

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