

Mycological Assessment Of Woody Plants Used For Greening In Baku

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As a result of the conducted studies, it has been established that 95 species of fungi participate in the formation of mycobiota of more than 100 tree species used in the greening of the city of Baku. From them 5 species (*Herpotrichia juniperi* (Duby) Petr., *Cenangium abietis* (Pers.) Duby, *Dothidella ulmi* (C.-J. Duval) G. Winter, *Fusicladium saliciperdum* (Allesch. & Tubeuf) Tubeuf, *Onnia triquetra* (Pers.) Imazeki) are new for the mycobiota of Azerbaijan and 69 species for pathogens. It was established that the trees like as Ordinary pine, Eldar pine, juniper, cypress, Japanese medlar, stone oak, oriental plane and others were more resistant to the impact of pathogens and their use in the greening of the Baku city is advisable.

Keywords: *Planting of greenery, mycobiota, phytopathogenic species, prevalence frequency, resistant species*

INTRODUCTION

As is known, greenness and planting of greenery as an integral structure of urbanization are constant a component of ecological carcass. So that, they able to perform like as environment-forming and protecting factor also as a valuable surveillance and control object to protects the comfort life of people, and as an indicator of conditions and quality of life in the any residential area (Avdeeva, 2008). In other words, they do not only beautify of the city, they also has important ecological function like as sanitary-hygienic, recreation, historical, environment forming and others.

On the other side, the growth conditions of plants which forms the greenness in the urban environments sharply differs from the same plants in the natural environment by ecological indicators. It is also causes to change the condition of plants which is using in the planting of greenery (Kovyazin et al., 2002). As a result, in some of them is observed unpleasant situations like as plant leaves drying up, gradually losing their decorative appearance and biological activity and others. Although, the cause of these cases is different, the role of microorganisms, primarily role of fungi which causes pathologies is not in the last place. Because as a result of fungi activity plants could be weaken, even massively destroyed (Horst, 2013). In the formation of any region's biodiversity, also in the carrying out of planting of greenery are used both native and introductory plants (Korpauchinsky et al., 2013; Tomoshevich et al., 2013). Fungi and their pathogenic species is a natural contaminate of plants

and introduced plants cause to forms a new ecological environment for them, for that there is no doubt that the plants which used for this purpose is a potential source for the spread of pathogen species.

In the most of the work which carried out general in Azerbaijan and in the big cities (Baku, Ganja, Sumgayit, Shirvan, etc.) was dedicated to the taxonomic definition of pathogenic mycobiota, mainly to micromycet composition in the tree plants (Abdullayeva et al., 2014; Jabrayilzade et al., 2014). In most cases researchers content with observations to the pathogens as a fragment forms. From this point of view, is very important to assessment potential damage of plants cause by diseases and implementation of complex measures to combat pathogens, including investigation of additional sources in concrete ecological-geographical conditions, the biological analysis of parasitic fungi and the formation of pathocomplex, also determination the resistance of used plants to the effect of pathogens.

Therefore, the main purpose of the present work is to evaluate the taxonomic composition of the mycobyta of trees (aborigene and introduced) used for greening in Baku, the largest city of Azerbaijan and the influence of pathogens involved in its formation to the durability of the trees used for greening .

MATERIALS AND METHODS

Samples for researches were taken from trees in streets and avenues, parks and gardens and these areas were mainly located in the central part of the city of Baku (located in some areas of the Sabail,

Yasamal, Nasimi, Narimanov, Khatai Sabunchu and Surakhani districts of Baku) which has anthropogenic burden.

The samples were taken systematically (Route) and unsystematically, and the taken samples were analyzed according by the known mycology methods (Methods of experimental mycology, 1982). Samples also were taken in the different seasons. Overall, during the period of research were taken approximately 1000 samples.

The frequency of use of plants in urban greening is calculated according to the following formula:

$$N = n/s,$$

here N - using frequency (pcs / ha), N - the number of concrete species found in the studied street, avenue, park, and etc. places.

The frequency distribution of fungi on the trees used for greening, also spread rate of diseases caused by pathogenic cultures were calculated according to the following formula:

$$P=(n/N) \times 100$$

here, P - frequency rate of fungi according to the sample (or spread rate of diseases caused by pathogenic-%), n - number of founds fungi (the total number of infected plants in the study area, piece), N - the total number of samples (Total number of plant species taken from sample).

RESULTS AND DISCUSSION

As noted, the purpose of the presented work is devoted to the researches related to the micrological evaluation of plants used in greening of Baku city. For this reason in our research firstly were considered appropriate to characterize the species composition of fungi which resides in these plants, more accurate in this trees. Before bringing the information about the taxonomic structure of the recorded fungi, we would like to bring some statistical information about of trees which used for greening. According to the literature and to the our observations in Baku the number of local and introduced trees which is using in the greening more than 100 species and their used is characterized by different rate in the urban greening (Abdullayeva et al., 2014). Thus, among of broad-leaved which is used in the greening of Baku city is encountered plants like as European olives, Japanese sakura, East willow, but among of coniferous is encountered plants like as Eldar pine

and cypress. At least for the reason that, this plants is encountered in any streets, parks and gardens. In addition, poplar, white mulberry and etc. plants also considered widely used in the greening of Baku.

As a result of analysis of samples taken from these or other trees, it became clear that in the formation of overall mycobiota of this trees participates 95 species of fungi. Their taxonomic structure was given in the table 1. according to the system which given on the official website of the International Association of Micology (<http://www.mycobank.org/Mycotaxo.aspx>).

As seen, the number of anamorphs of sac fungi are much more than from the fungi belonging to the other taxonomic groups and 50,5% of fungi recorded during research fall to their share. The second place with 31.6% belongs to Basidial fungi, the next places with 10,5% belong to anamorphs of sac fungi, and 7,4% to the Zygomycetes. It should be noted that, many fungi were recorded in the various mycological research in different biotope of Azerbaijan, that is, most of their areal is included the territory of Azerbaijan. However, among of registered fungi met fungi which was firstly recorded in the territory of Azerbaijan. Their taxonomic affiliation and information about the plant-owner was given in the table 2. As seen, 3 of 5 types that fitting this characteristic belong to the teleomorphs of sac fungi, 1-to the anamorphs, 1 to the basidial fungi. Interestingly that, all of these fungi recorded for the first time are related to a certain extent due to pathogenicity and cause different diseases in their own plants. One of the interesting aspects of the issue is that, this fungi were recorded in the plants which mainly used in the greening of Baku in the recent years. This fact allows to record the importance of improvement of the monitoring system for the carefully checked of plants used in the greening in terms of mycological safety.

Although this information may have a general view but it can not be considered sufficient for the evaluation of the mycological safety of trees used in the greening in the city of Baku. For this reason, at the next stage of the research was identified pathologies caused by registered fungi, the distribution of fungi and their pathologies on the different species of trees and trees resistant to pathologies.

Table 1. Taxonomic structure of fungi located in the trees which used in the greening of Baku city.

Kingdom	Division	Class	Order	Family	Genus	Species
	<i>Zygomycota</i>	1	1	1	3	7
Mycota	<i>Ascomycota</i> (Teleomorf)	1	3	3	6	10
	<i>Ascomycota</i> (Anamorf)	4	8	11	25	48
	<i>Bazidiomycota</i>	2	5	9	19	30
Total		8	16	23	46	95

Table 2. Taxonomic affiliation of fungi species which first time were registered in the Azerbaijani nature.

Division	Species	Own plants
<i>Ascomycota</i> (T)	<i>Herpotrichia juniperi</i> (Duby) Petr.	Juniper
<i>Ascomycota</i> (A)	<i>Cenangium abietis</i> (Pers.) Duby	Fir-tree
	<i>Dothidella ulmi</i> (C.-J. Duval) G. Winter	Fir-tree
	<i>Fusicladium saliciperdom</i> (Allesch. & Tubeuf) Tubeuf,	Ulmus
<i>Bazidiomycota</i> (B)	<i>Onnia triqueter</i> (Pers.) Imazeki	Willow
		Fir-tree

Table 3. Specific weight of pathogens among registered fungi.

Division	Total number of registered fungi species	Which were included to the epiphyte mycobiota or do not have pathogenicity	Species which have confirmed of pathogenicity	The status of those who unknown
<i>Zygomycota</i>	7	5	1	1
<i>Ascomycota</i> - T	10	1	8	1
<i>Ascomycota</i> - A	48	7	37	4
<i>Bazidiomycota</i>	30	5	23	2
Total	95	18	69	8

Table 4. Distribution of registered fungi on the separate trees used in the greening in the Baku city.

Plants	<i>Zygomycota</i>	<i>Ascomycota</i>	<i>Bazidiomycota</i>	Total number of registered species	Spread rate of pathogens(%)
East willow	1	7	5	13	3,4
European olives	1	19	3	23	7,6
Japanese safura	1	17	4	22	56,7
Eldar pine	0	6	2	8	0,5
Ordinary poplar	1	19	12	32	33,4
White mulberry	1	15	4	20	31,7
Chinese Ailanthus	1	13	3	17	12,1
Ordinary cypress	1	5	2	8	0,9
Japanese medlar	0	9	1	10	0,8
Southern willow	1	18	14	33	34,5
Stone oak	0	8	4	12	2,1
White acacia	1	18	8	27	19,6
Ulmus	1	12	6	19	9,8
Ash-tree	0	14	6	20	7,6
Others	1	20	6	30	0,2-7,6

It is known that in the formation of pathology are involved one or more types of fungi (Horst, 2013). According to the literature data, also to the our observations were identified that most of the recorded fungi are related to one or more pathogenicity (Table 3). As seen, 14.7% of the registered fungi belongs to the saprotrophs which are fed only with dried plant organs, they also participate in the formation of the epiphytic mycobiota of these plants. As seen, the remaining fungi by ecolo-trophic view belongs to the biotrophs or polytrophs. Logically, all these can be characterized as a pathogenic related species, but it can not be considered sufficient to say this idea about the results which obtained from our or other researchers. For this reason, we considered necessary to combine some fungi in a third group, namely in the unidentified group. 8,4% of fungi recorded in our research is corresponds to the this characteristic which to determination of their status can be identified as a result of future research.

The next issue of research were to identify the distribution of pathogenic species of fungi which

participating in the formation of mycobiota of different types of trees used in the greening of Baku city. It became clear that, the mycobiota of plants used in greening differ from each other according to the species composition (Table 4). As seen, by the number of recorded fungi Southern willow and Ordinary poplar is in the first place, but for the degree of spread rate of pathogens Japanese safura is in the first place.

Interestingly, most of pathogens that spread on the plant are related to one species, ie *Inonotus hispidus*. We can say, these fungi is encountered in one of the two plant in Baku city. Although, is encountered the ephitotia associated with the spread of the fungi but, during the research, as well as the analysis of literature data, did not detect full dryness of these plants due to effect of this fungi. This situation also can be characterized as mild parasitism.

It would be good to touch one issue, about greening of Baku city, namely trees which used for the greening in the parks and gardens. This is due to the fact that Baku is located in the Absheron

Peninsula, one of the most drought regions of Azerbaijan, as well as in the Caucasus and therefore, here subtropical plants is more and their weight in urban greening is quite high (<http://eco.gov.az/en>). The results about these plants namely about olive are presented in Table 4, but information about of mycobyta of other dry subtropical plants, such as almond, pistachio, ziziphus, elaeagnus, etc. is presented in the generalized forms in the same table under "others". Among the fungus involved in the formation of the mycobiota of these dry subtropical plants, are encountered representatives of all taxonomic structures of the Mycota kingdom and inside these plants to impact of fungi most durable was ziziphus, and most unstable was pistachio. Nevertheless, a number of issues (Influence of fungi-plant relationships to their biological productivity and to the decorative appearance and the issues related to explanation of character of changes for that reason) related to the use of these plants in the conditions of Absheron, especially in the creation greening areas have not been solved scientifically, so the issue is open to research.

At the end of the research were conducted experiments to obtained information about diseases

caused by pathogenic fungi participating in the formation of mycobiota of trees used for greening in the Baku city, their prevalence rate and information about developmental cycles of some of the disease-makers fungi. It became clear that, the most spreads disease is brown decay and leaf stains which in their occurrence are participate various types of fungi (Table 5). As seen, the most commonly spread diseases were on the plants like as Japanese falcon, southern willow, ordinary poplar, white mulberry, and so on. In generally, it should be noted that the plants used in the greening in the Baku city shows different resistance to diseases caused by fungi which allowed us to notes the advisability to characterize these trees in this aspect and in this aspect distribution rate of diseases was taken as the main distinguishing criterion.

It became clear that, the trees used for greening in Baku in general can be divided into five groups (Table 6). As seen, into first group includes highly resistant plants like as conifers plants and species that are relatively new in the history of use in greening, in them distribution rate of common diseases is not more than 5%.

Table 5. Fungal diseases observed in the trees used in the greening in the Baku city and their prevalence rate (%).

N	The name of the disease	Disease causing fungi	Observed tree	Distribution rate
1	Brown trunk decay	<i>I.hispidus</i>	Japanese safura White mulberry White acacia	12,6-56,7
2	Brown trunk decay	<i>F.pinicola</i>	Ordinary poplar South willow	7,8-12,8
	Brown root decay	<i>F.pini</i>	Eldar pine Ordinary pine	2,1-4,3
3	White trunk decay	<i>F.fomentarius</i> <i>G.applanatum</i>	Ordinary poplar South willow	7,8-11,2
4	Stains	<i>A.alternata</i> <i>C.microsora</i> <i>L.fumago</i> <i>Ph.opuli</i> <i>S.populi</i> <i>Ph.ulmi</i> <i>Rh.salicinum</i>	European olives Linden South willow Stone oak Ulmus	1,2-3,9
5	Rust	<i>M.populnea</i> <i>M.salicina</i>	South willow Ordinary poplar	1,7-3,4
6	Powdery mildew	<i>E.alphitoides</i>	European olives South willow	2,3-5,4
7	Necrosis	<i>N.cinnabarina</i> <i>C.quercina</i>	Ordinary poplar Ulmus Linden Stone oak	0,7-1,4

Table 6. Characteristics of trees used in the greening in the Baku city according to the sustainability to the diseases.

Species having high durability	Durability species	Slightly disease-carrying	Medium degree disease-carrying	Strongly disease-carrying
Ordinary pine Juniper Cypress Japanese medlar	Stone oak Plane Eldar pine Ordinary eucalyptus	Gleditsia caspica Chinese Ailanthus Fraxinus Crying Willow	White acacia Ulmus Linden European olives	Japanese safura South willow Ordinary poplar White mulberry

In the secondary group includes durably trees species like as coniferous and broad-leaved trees and in them distribution rate of diseases is up to 10%. In the next places are includes those weaker than 20%, 30% and over than 30%. In our view, is useful to take them into account in the greening to provide the anthropogenic environments on the view of Sanitary-hygienically.

From the carried out of research was determined that, the trees used in the greening of Baku city are characterized by rich mycobiota and in the formation of mycobiota are participate 95 species of fungi. From them 5 species are new for the mycobiota of Azerbaijan. The sustainability indicator of used trees on pathogens is different. To used the trees like as Ordinary pine, cypress, Japanese medlar, stone oak, oriental plane and others in the greening of Baku city is more advisable.

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Bakı Şəhərinin Yaşıllaşdırılmasında İstifadə Edilən Oduncaqlı Bitkilərin Mikoloji Qiymətləndirilməsi

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Aparılan tədqiqatlardan müəyyən edilmişdir ki, Bakı şəhərinin yaşıllaşdırılmasında istifadə edilən 100 növdən artıq ağacın mikobiotasının formalaşmasında 95 göbələk növü iştirak edir. Qeydə alınan göbələklərin 5 növü (*Herpotrichia juniperi* (Duby) Petr., *Cenangium abietis* (Pers.) Duby, *Dothidella ulmi* (C.-J. Duval) G. Winter, *Fusicladium saliciperdu* (Allesch. & Tubeuf) Tubeuf, *Onnia triqueter* (Pers.) Imazeki) Azərbaycan təbiətinə xas olan mikobiota üçün yeni, 69 növ isə patogenlərə aiddir. İstifadə edilən ağacların patogenlərin təsirinə davamlılıq göstəricisinin qiymətləndirilməsi nəticəsində müəyyən edilmişdir ki, Bakı şəhərinin yaşıllaşdırılmasında Adi şam, Eldar şamı, Ardıc, Sərv, Yapon əzgili, Daş pəlud, Şərq çınarı və s. kimi bitkilərin istifadəsi daha məqsəduyğundur.

Açar sözlər: Yaşıllaşdırma, mikobiota, fitopatogen növlər, yayılma dərəcəsi, davamlı növlər

Микологическая Оценка Древесных Растений, Используемых В Озеленении Города Баку

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В результате проведенных исследований установлено, что в формировании микобиоты более чем 100 видов деревьев, используемых в озеленении города Баку, участвуют 95 видов грибов. Обнаруженные 5 видов грибов (*Herpotrichia juniperi* (Duby) Petr., *Cenangium abietis* (Pers.) Duby, *Dothidella ulmi* (C.-J. Duval) G. Winter, *Fusicladium saliciperdu* (Allesch. & Tubeuf) Tubeuf, *Onnia triquetra* (Pers.) Imazeki) оказались новыми для микобиоты Азербайджана, а 69 видов – патогенами. При оценке показателя устойчивости используемых деревьев к действию патогенов выявлено, что в озеленении города Баку наиболее целесообразно использование таких растений как сосна обыкновенная, Эльдарская сосна, можжевельник, кипарис, мушмула японская, дуб каменный, восточный чинар и т.д..

Ключевые слова: *Озеленение, микобиота, фитопатогенные виды, степень распространения, устойчивые виды*