Monitoring of diseases and pests of tree plantations in the North-Eastern Administrative District of Moscow

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Abstract. The data of monitoring of tree plantations in the North-Eastern Administrative District of Moscow for 2019-2020 are presented. During the analysis, characteristic plant diseases and injuries were identified, as well as species resistant to parasites and diseases. Severe damage was found by marginal necrosis and powdery mildew, leafhoppers and leaf-gnawing insects.

Keywords: plant resistance, tree species, environmental problems, urbanized environments, urban green spaces, plant diseases and pests.

Introduction

It is impossible to deny the degree of significance of green spaces in the lives of people and the whole planet in general. Forests perform not only nature conservation and biospheric functions, but also largely satisfy various human needs - recreational, social and aesthetic. A particularly significant role is assigned to green spaces that grow in large cities. The positive influence of plants on the physical and psycho-emotional state of the inhabitants of megacities is well known. It should be noted that only healthy forests can fully fulfill their functions [2,5].

One of the reasons for the weakened state of woody plants in the city is their damage by pests and diseases.

A huge number of insects cause significant damage to trees, destroying their leaves, bark, flowers and fruits. Due to the fact that insects destroy foliage and needles, successive changes occur in the life of plants. Thus, trees that have lost their foliage (needles) demonstrate a violation of photosynthesis and water exchange, due to which the growth and their stability are reduced or completely stopped. As a rule, conifers react more sharply to partial or complete loss of greenery than deciduous ones. As a result of gnawing needles (and with repeated gorging), the growth is very sharply reduced, which leads to drying out. Such plantations are more often attacked by stem parasites [1].

Significant damage to urban plantings is caused by such pests as:

- linden — comma-shaped scale insect, forging, linden aphid, linden felt mite, cobweb mite, moth;
- oak — oak yellow aphid, green oak leafworm;
- poplar — unpaired and ringed silkworms, comma-shaped scabbard, flat poplar aphid, poplar moth;
- elm — elm multiflorum, scoops, elm beetle;
- larch — conifer mite, cap moth.

There are also many pests of all kinds on mountain ash, acacia, lilac, wild rose, hawthorn, cotoneaster, as well as other shrubs and trees [3].

Among the pests, the most dangerous is the narrow-bodied ash emerald, the Ohrid miner is found in the chestnut plantations, the peculiarities of weather conditions can cause outbreaks of aphids and leaf-eating pests.

The green spaces of the city of Moscow most often suffer from diseases such as thyrostromosis (common in linden plantations), rotten diseases, and elms are susceptible to graphiosis.

Tyrostromosis (infectious drying out) of linden is caused by fungi of the genus Thyrostroma compactum, which, penetrating into the tissues of young branches, cause the formation of necrotic areas, then the infection penetrates into larger branches. After the thin branches die off, bunches of shoots are formed in their place, which give the tree an untidy "disheveled" look. Despite the fact that thyrostromosis is not a dangerous disease, it gradually weakens the tree, deforms the crown, and reduces decorative qualities, especially damaging young plants [4].

A large number of phytopathological and entomological studies, including consideration of regional forest plantations, do not contain sufficient information on assessing the resistance of trees to pests and diseases in certain habitats.

Therefore, the purpose of our research was to study the peculiarities of damage to woody plants of the North-Eastern Administrative District of Moscow by pests and diseases, depending on the ecological conditions of the years and places of growth.

Methods

The objects of research were 29 species of woody plants, of which 4 species grew on Mira Avenue, 13 on the Alley of Space Heroes, 14 at VDNKh, 15 in the park along Malyginsky Proezd and 15 species in the Alekseevskaya Gorka park. The list of investigated species is presented in table. 1.

Table 1 – Species composition of woody plants in research

Peace Avenue	**Square on Malyginsky proezd**

1. Small-leaved linden (Tília cordáta)	1.Black chokeberry (Arónia melanocárpa)
2. Balsam poplar (Populus balsamifera)	2.Hanging birch (Bétula péndula)
3. Norway maple (Acer platanoides)	3. Elm smooth (Ulmus laevis)
4. Ash-leaved maple (Acer negundo)	4. Tree caragana (Caragana arborescens))
Alley of space heroes	5. Norway maple (Acer platanoides)
1. Ottawa barberry (Berberis × ottawensis)	6. Ash-leaved maple (Acer negundo)
2. Hawthorn (Crataegus laevigata)	7. Small-leaved linden (Tília cordáta)
3. Hanging birch (Bétula péndula)	8. Willow brittle (Sálix fragílis)
4. Elm smooth (Ulmus laevis)	9. Bubble-leaf Vine-leaved (Physocarpus opulifolius)
5. Tree caragana (Caragana arborescens)	10. Mountain ash (Sorbus aucuparia)
6. Horse chestnut (Aesculus hippocastanum)	11. Hungarian lilac (Syringa josikaea)
7. Cotoneaster brilliant (Cotoneaster lucidus)	12. Common lilac (Syrínga vulgáris)
8. Norway maple (Acer platanoides)	13. Snowberry white (Symphoricarpos albus)
9. Tatar maple (Acer tataricum)	14. Japanese spirea (Spiraea japonica)
10. Small-leaved linden (Tília cordáta)	15. Balsam poplar (Populus balsamifera)
11. European larch (Larix decidua)	**Alekseevskaya Gorka**
12. Mountain ash(Sorbus aucuparia)	1. Ottawa barberry (Berberis × ottawensis)
13. Bird cherry (Prunus padus L.)	2. Hawthorn (Crataegus laevigata)
Approaches to VDNKh	3. Hanging birch (Bétula péndula)
1. Hanging birch (Bétula péndula)	4. English oak (Quercus robur)
2. Hawthorn (Crataegus laevigata)	5. Tatar honeysuckle (Lonícera tatárica)
3.Tree caragana (Caragana arborescens)	6. Ginnal's maple (Acer ginnala)
4. Horse chestnut (Aesculus hippocastanum)	7. Ash-leaved maple (Acer negundo)
5. Norway maple (Acer platanoides)	8. Small-leaved linden (Tília cordáta)
6. Tatar maple (Acer tataricum)	9. Willow brittle (Sálix fragílis)
7. Ash-leaved maple (Acer negundo)	10. Mountain ash (Sorbus aucuparia)
8. Small-leaved linden (Tília cordáta)	11. Hungarian lilac (Syringa josikaea)
9. European larch (Larix decidua)	12. Common lilac (Syrínga vulgáris)
10. Mountain ash (Sorbus aucuparia)	13. Balsam poplar (Populus balsamifera)
11. Common lilac (Syrínga vulgáris)	14. Bird cherry Maak (Padus maackii)
12. Golden currant (Ribes aureum)	15. Home apple (Malus domestica)
13. Bird cherry (Prunus padus L.)	
14. Dog rose (Rósa canína)	

In June - August 2019-2020, samples of damaged leaves were taken and the latter were determined to belong to one or another species (genus) of agents that led to the damage.

The selected research sites are lively, intended for city-wide use, and their role is to provide a link between the community center and industrial and transport areas, as well as main streets.

Moscow is a city with a temperate continental climate, but the degree of its continentality, in comparison with other megalopolises in Europe, is an order of magnitude higher. The largest value of the annual amplitude of the temperature difference in Moscow was recorded at the level of 28 degrees. The city is characterized by rather severe and long winters.

The weather and climatic conditions prevailing in Moscow in 2019 were favorable for vegetation. In the winter season from January to March, the amount of precipitation exceeded the norm, due to which the plants were not subjected to temperature stress, and a sufficient moisture reserve was formed in the soil. No frosts were observed after the snow melted, the beginning of summer (June) was very warm and humid, so the vegetation was able to gain significant phytomass.

In July and August, the amount of precipitation was below normal, but if in June there were rather high temperatures (which could lead to a moisture deficit), then in July and August there was no heat. There were no outbreaks of insect pests during the 2019 growing season.

In 2020, the following temperature indicators were recorded: the minimum air temperature in January is 6.6 °C; the maximum air temperature in July is 20.1 °C.

Depending on the month, the humidity varied in the range from 66% to 86%. At the same time, the minimum humidity in Moscow was observed in April, the maximum - in December.

According to the Hydrometeorological Center, the anomalous months in terms of precipitation were June and July 2020, when about 200% of the norm fell, as well as August, which did not reach the norm of 60% of precipitation.

Results

The following pests were recorded at the facilities of the North-Eastern Administrative District of Moscow: aphids, leaf-eating, leafhoppers, miners, sawflies (tab. 2).

The most common tree pests on Mira Avenue both in 2019 and in 2020 were spider mites, slimy sawflies and miner fly. In 2019, a large number of spider mites and leafhoppers were observed on the Alley of Heroes of Space. In 2020, the championship went to other types of pests: slimy sawfly, aphids, spruce-larch hermes.

In 2019, plantations at the facility next to the arch of the VDNKh main entrance were affected by leafhoppers, and in 2020 by aphids. At the same time, during the observation period from 2019 to 2020, the following pests were observed in the same amount: mining sawfly, spider mite, spruce-larch hermes, felt mite, Ohrid miner.

In the park on Malyginsky passage from 2019 to 2020, a large number of leafhoppers, leaf-gnawing, spider mites were found on plants. Moreover, most of the plantings in 2020 were affected by aphids.

Plantings in the Alekseevskaya Gorka park zone in 2019 were characterized by the presence of a large number of spider mites and leafhoppers. In 2020, plants in this area were attacked by aphids.

In addition, at the greening objects, near the arch of the main entrance to VDNKh and in the park "Aleseevskaya Gorka", minor lesions of trees and shrubs were revealed by a three-rayed mite, a felt mite, a mining sawfly, a thick-walled sawfly, a sawfly rosary, a mountain ash moth, a poplar mite.

Table 2 - Species diversity of pests on trees and shrubs in urban green spaces of the North-Eastern Administrative District of Moscow.*

Views	Peace Avenue		Alley of Heroes of Space		Approaches to VDNKh		Square on Malyginsky Avenue		Alekseevskaya Gorka	
	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020
Spider mite	1/25	1/25	2/15	1/8	2/14	2/14	4/27	4/27	3/20	2/13
Slimy sawfly	1/25	1/25	1/8	1/8	-	-	-	-	1/7	1/7
Aphids	-	-	2/15	2/15	1/7	4/28	1/7	3/20	1/7	5/33
Cicadas	-	-	6/46	4/31	5/36	3/21	4/27	4/27	6/40	3/20
Spruce-larch hermes	-	-	1/8	1/8	1/7	1/7	-	-	-	1/7
Ohrid miner			-	-	1/7	1/7	-	-		1/7
Miner front sight	1/25	2/50	-	-	-	-	2/13	2/13	-	-
Cap moth	-	-	-	1/8	1/7	1/7	1/7	1/7	-	-
Leaf-eating	-	-	3/23	5/38	1/7	3/21	9/60	10/60	-	3/20
Weevils	-	-	-	-	1/7	1/7	4/27	2/13	-	-

*In the numerator – the number of damaged tree species, in the denominator -% of the total number of trees and shrubs

During the observation period in 2019-2020, 5 main types of diseases were identified for 29 species of woody plants (tab. 3).

Table 3 - Diseases of trees and shrubs in urban green spaces of the North-Eastern Administrative District of Moscow*

Views	Peace Avenue		Alley of Heroes of Space		Approaches to VDNKh		Square on Malyginsky proezd		Alekseevskaya Gorka	
	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020
Powdery mildew	2/50	2/50	3/23	5/38	5/36	6/43	8/53	8/53	3/20	4/27
Marginal necrosis	1/25	3/75	2/15	2/15	4/28	4/28	3/20	2/13	1/7	-

Phylostictosis	1/25	1/25	2/15	-	2/14	2/14	1/7	1/7	1/7	1/7
Chlorosis	-	-	-	-	2/14	1/7	1/6	2/13	1/7	1/7
Marsiniosis	1/25	1/25	-	-	-	-	1/7	1/7	-	-

*In the numerator – the number of damaged tree species, in the denominator -% of the total number of trees and shrubs

Among them, in all the years of research, powdery mildew was absolutely dominant in all areas; it affected more than 80% of all surveyed trees.

A large proportion of trees were also found with leaf lesions with marginal necrosis (up to 35%).

In 2019 and 2020, at the facility near the arch of the main entrance to VDNKh, a tendency was revealed for plantings to be damaged by tirastramosis and cytosporosis (7% of trees). in the public garden on Malyginsky proezd - black spot, rust, scab (6%). In the Alekseevskaya Gorka park, cases of scab and rust were detected only in 2019 (6%).

The most vulnerable to diseases were the small-leaved linden, balsam poplar and ash-leaved maple.

Unfavorable living conditions in an urban environment lead to premature death of trees. Thus, the number of fallen trees in the North-Eastern Administrative District of Moscow in 2019 increased compared to 2018 by 6%, and in 2020 decreased compared to 2019 by 65% (table. 5).

Table 5 – The number of fallen trees in the NEADM

№	Year	NUMBER OF FALLEN TREES, PCS
1	2018	659
2	2019	698
3	2020	247
	Total:	1604

Conclusion

Urban street plantings of trees are characterized by a low level of species diversity, and the similarity with forest communities is minimal. They grow in conditions of a high level of technogenic air pollution and maximum changes in light and temperature conditions. The life span of trees is significantly reduced in comparison with that in natural conditions due to the high level of anthropogenic load on soil and plants. In parks and forest parks, diseases of the leaves of shrubs and trees are more common than in squares and street plantings. Due to chemical air pollutants, the development of phytopathogens and pests can be suppressed.

At the same time, favorable conditions can be created for the development of some diseases, for example, necrosis on weakened trees, resistant to air pollution of pathogens.

The number of pests is also affected by chemical, thermal pollution. It can vary from mild to flash, influenced by weather conditions. At the same time, cyclical fluctuations are less noticeable.

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