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EUROPEAN MISTLETOE (*VÍSCUM ÁLBUM* L.) IN NATIONAL BOTANICAL GARDEN M.M. GRUSHKO NAS OF UKRAINE: AN OVERVIEW OF ITS DISTRIBUTION AND HOSTS

E. Yelpitiforov, Y. Klymenko

The aim. *To give a brief literature review of the biological features of Viscum album L., transpiration of these plants, features of the systematic situation, distribution in the world. There was determined the distribution and general trends of the semi-parasite plant on the territory of the National Botanical Garden named after M. M. Grishka NAS of Ukraine.*

Materials and methods. *The research was conducted on the territory of the National Botanical Garden named after M. M. Grishka NAS of Ukraine. Visual inspection of trees and bushes for Viscum album L. was carried out, their location was determined, followed by presentation of the results on the map of the botanical garden. The degree of damage to host plants was determined.*

Results. *The map of the National Botanical Garden (NBG) named after M. M. Grishka of the National Academy of Sciences of Ukraine with the affected plants marked on it, is presented. A generalized list of host plants inhabited by Viscum album L. on the territory of the NBS has been compiled. The most affected plants were identified and found to belong to 7 orders of magnitude.*

Conclusions. *The total number (50) of plants introduced to the NBG, on which Viscum album settles, as well as the areas with the largest number of affected plants were determined. For the results of the study, we examined the V. album, which is supported to the following files Fabales, Fagales, Lamiales, Malpighiales, Malvales, Rosales and Sapindales. Identified a larger number of affected semi-parasites of cultivation - Robinia pseudoacacia, which has many plants in the NBG*

Keywords: *Viscum album, host plants, distribution, botanical garden*

1. Introduction

In total, the genus Viscum L. includes 70 species, among which the most common is White Mistletoe (Viscum album L.) and its subspecies. *V. album* is distributed almost throughout Europe and in Ukraine [1]. Its role is ambiguous, because, on the one hand, the fruits of *V. album* are birds feed, it is also used in medicine, and on the other – it is a semi-parasite that causes changes in the water balance of the host plant, thereby weakening it [2]. Plants inhabited by *V. album* are more likely to be affected by pathogens and pests than healthy ones.

2. Literature review

According to the literature, a total of 452 subspecies, species and hybrids belonging to 96 genera in Europe, Asia and North America are affected by plants of the genus Viscum, including 184 species of trees and shrubs introduced in Europe [3].

In Ukraine, *V. album* is widespread in Prykarpattia, Polissya, forest steppe and Crimea. According to the latest data, species of plants related to Viscum, genera – Arceuthobium oxycedri (DC.) M. Bieb, have been found in Ukraine. and Loranthus europaeus Jacq., which inhabit junipers and oaks, respectively.

The issue of water balance of *V. album* itself remains open, as it is an evergreen plant and is capable of transpiration in winter [3].

Also controversial is the idea of the semi-parasitic nature of *V. album*. Some researchers are inclined to believe that the plant is a semi-parasite because it photosynthesizes organic matter [4], others consider it a parasite, based on the insufficient amount of sugars produced by *V. album* to provide itself completely [5].

3. The purpose and objectives of the study

The purpose of the study was to determine the distribution and general trends of Viscum album L. in the territory of the National Botanical Garden named after M. M. Grishka NAS of Ukraine.

To achieve this goal, the following tasks were set:

1. Identify and mark the host plants, given the location of the semi-parasite in the collection and exhibition areas of the National Botanical Garden (NBG) named after M. M. Grishka NAS of Ukraine, according to botanical and geographical zoning.

2. Develop a detailed map of the botanical garden with the affected plants marked on it.

3. To make the generalized list of host plants on which *V. album* in the territory of NBG settles.

4. Identify the most affected plants and establish their systematic position.

4. Materials and methods

The research was conducted on the territory of the National Botanical Garden named after M. M. Grish-

ka of the National Academy of Sciences of Ukraine in February-March 2020. A visual inspection of trees and shrubs for *V. album* was performed. The species affiliation of the host plants was established according to the inventories of the collection and exposition areas of the botanical garden (unfortunately, they are not complete, so not all species affected by *V. album* were identified).

The degree of damage to host plants was determined by the method of Chekalin M. M. (2003) (Table 1).

Table 1

Indicators of the degree of population of *V. album* host plants at the studied objects according to the method of Chekalin M. M.

Affection	Percentage	Stage
Missing or very weak	up to 10 %	1
Weak	15–20 %	2
Average	21–50 %	3
Strong	51–75 %	4
Very strong (limiting)	more than 75 %	5

Affected plants were applied to the map of the botanical garden by the point method.

5. Research results

Based on the results of visual inspection of trees and shrubs on the territory of the NBG for damage to their *V. album*, a generalized list of host plants was compiled (Table 2).

In total, *V. album* inhabits 50 species of plants introduced into the NBG. These are plants from the families Betulaceae, Cannabaceae, Fabáceae, Fagáceae, Juglandaceae, Malvaceae, Oleaceae, Rosáceae, Rutaceae, Salicaceae, Sapindáceae.

Affected plants are marked on the map of the NBG (Fig. 1), according to the division of the botanical garden into collection and exhibition areas.

Most of the plants affected by V. album were found in the areas of "Rosaceae", "Birch Grove", "Beech Oak", as well as in the area behind the orchard adjacent to the slope overgrown with robinia. Quite a lot of V. album in the areas "Far East", "Horse chestnut", on the linden alley, on the old trees near the main entrance to the botanical garden and near the area "Indonesian Garden".

V. album was not detected in the area "Gymnosperm", because conifers are not affected by the typical V album, and in the area "Orchard", where it is regularly removed. There is almost no V. album in the dense beech forest, which is adjacent to one side of the track (probably beech – resistant to V. album species). There are also very few affected plants near farm buildings.

Determining the degree of damage to the host plant showed that the highest degree of damage according to the area of the crown in NBG have the plants shown in Fig. 2.

Table 2

Plants of the National Botanical Garden named after M. M. Grishka, who were affected by Viscum album L.

№	Plant	Species
1	*Fabáceae*	*Robinia pseudoacacia* L.
2	*Betulaceae*	*Carpinus betulus* L.
3		*Betula ermanii**
4		*Betula klokovii* Zaverucha*
5		*Betula nigra* L.
6		*Betula papyrifera* Marshall*
7		*Betula pendula* Roth.
8		*Betula populifolia* Marshall
9		*Betula pubescens* Ehrh
10	*Fagáceae*	*Quercus rubra* L.
11	*Juglandaceae*	*Juglans cinerea* L.
12		*Juglans nigra* L.
13		*Juglans rupestris* Engelm
14	*Oleaceae*	*Fraxinus excelsior* L
15		*Fraxinus lanceolata* Borkh
16		*Syringa amurensis* Rupr.
17		***Syringa pekinensis* Rupr.**
18		*Syringa persica* L.
19	*Salicaceae*	*Populus x canadensis* Moench
20		*Populus tremula* L.
21		*Populus x canescens* (Ait.) Smith
22		*Salix alba* L.
23		*Salix fragilis L.*
24	*Malvaceae*	*Tilia amurensis* Rupr.
25		*Tilia cordata* Mill.
26		*Tilia heterophylla*
27		*Tilia platyphyllos* Scop.
28		*Tilia tomentosa Moench.*
29	*Cannabaceae*	*Celtis occidentalis* L.
30	*Rosáceae*	*Crataegus monogyna* Jacq.
31		*Malus domestica* Borkh.
32		*Malus niedzwetzkyana* Dieck Ex Koehne
33		*Malus pumila* Mill.
34		*Malus sylvestris* Mill.
35		*Prunus maackii* Rupr.
36		*Prunus padus* L.
37		*Pyrus communis subsp. pyraster* L
38		*Sorbus domestica* L.
39		*Sorbus hybrida* L.
40		*Sorbus intermedia* (Ehrh.) Pers.
41	*Sapindáceae*	*Acer negundo* L
42		*Acer platanoides* L.
43		*Acer pseudoplatanus* L.
44		*Acer saccharinum* L.
45		*Acer tataricum* L.
46		*Aesculus glabra* Willd.
47		*Aesculus hippocastanum* L.
48		*Aesculus pavia* L.
49		*Aesculus sylvatica* Bartr.
50	*Rutaceae*	*Phellodendron amurense* Rupr.

*Note: The table does not indicate plants that are not affected at all V. album, but presented into the NBG; * – the species of these plants needs to be checked*

Fig. 1. Map of NBG with adjacent territories, with plants marked on it, which are affected by Viscum album L. Note. One mark on the map is one affected plant

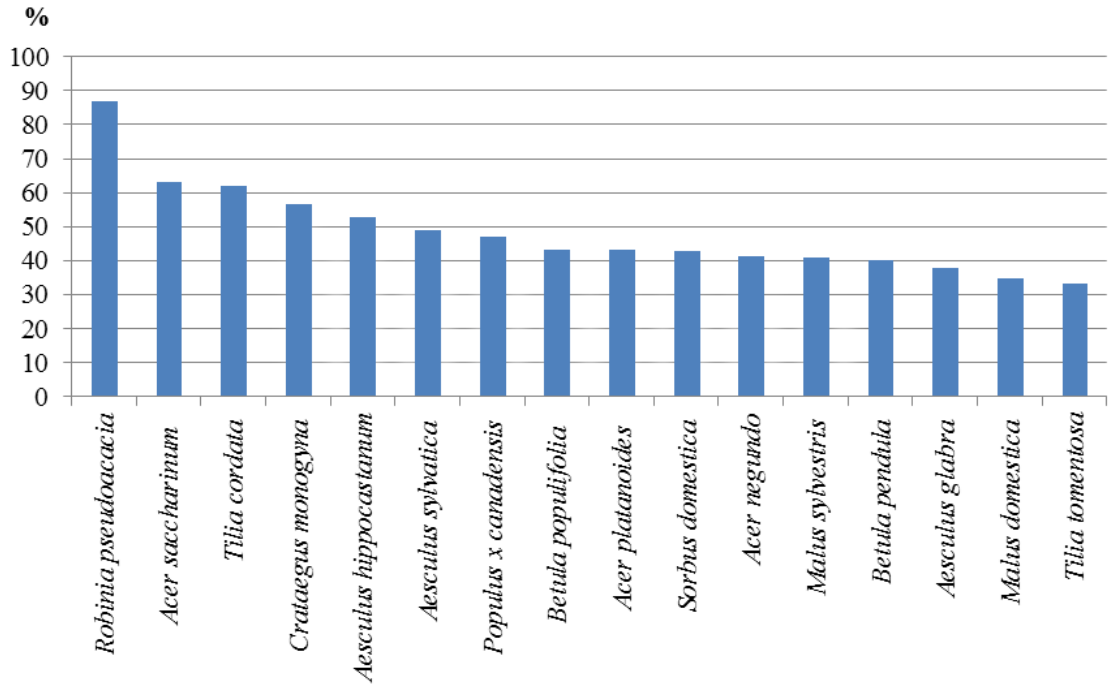

Fig. 2. Species most affected by Viscum album L. in the NBG (*more than 50 % of the plant crown)

The presence of both affected *V. album* and unaffected trees of the same species may indicate either that the seeds of *V. album* for some reason did not get on the plants, or that they were resistant (i.e. have some differences in genotype), or grow in better conditions, which makes them more stable.

The most affected are the plants Robinia pseudoacacia, which grows a lot both inside and outside the NBG. Thus, the success of the fight against *V. album* depends on the coordination of actions in the garden and in the city.

Among the deciduous plants on which *V. album* was not found, there are species from the families Bignoniaceae, Anacardiáceae, Simaroubaceae, Ulmaceae and some others. It should be noted that in the middle of the twentieth century. Suspended birch was considered resistant to *V. album* [8], which is now very much affected. This may be due to the fact that in the middle of the twentieth century. *V. album* has not yet become so widespread and did not have time to infect hanging birch plants, which led to a premature conclusion. Another reason may be climate change (climate aridization), which weakened the hanging birch and weakened plants became vulnerable to *V. album*. Finally, there may be forms in the population of *V. album* that have been found to be able to infect this species of birch.

In general, *V. album* is most often located at the top and inside the tree crown, but not always. Thus, on the apple alley you can see *V. album* on apple trees at a height of half a meter from the ground (Fig. 3).

Fig. 3. *Viscum album L.* on an apple tree at a height of 0.45 m from the ground

6. Discussion of research results

The results of our research confirm the data of I. O. Rybalka and Y. I. Vergeles about some host plants of *V. album*, in particular Populus deltoides [12]. Thus, according to our data, most of the alley plantations of poplar and linden in the NBG are significantly damaged by this semi-parasite.

According to Taran N. Yu., Batsmanova L. M., Meleshko A. A. [3] among deciduous species with high enough resistance to *V. album* is oak, hornbeam, beech, which is confirmed by our studies. At the same time, we have to disagree with the data of the same authors on the minor damage of white chestnut, red oak and walnut, because according to our observations, these plants are quite heavily populated *V. album* in NBG. This is due not only to the peculiarities of tree species, but also their age.

We believe that the threat of infection with *V. album* exists for every deciduous tree plant of the botanical garden. The tallest trees in the massifs and single trees are most often affected, as it is on them that *V. album* spreading birds first land. If such a plant is not removed, the seeds of the semi-parasite, which grows high in the crown, falls down and infects the lower branches, as well as transmitted by birds to neighbouring plants.

Study limitations can be considered populations of host plants on which diseases or pests, plants subject to sanitary felling and single trees have been detected.

Prospects for further researches. The results of the study can be used to control *V. album* and regulate its number on plants introduced in the NBS, as well as in further studies to identify patterns of damage to host plants.

7. Conclusions

1. As a result of the study, the host plants were identified, given the location of the semi-parasite in the collection and exhibition areas of the National Botanical Garden named after M. M. Grishka NAS of Ukraine, according to botanical and geographical zoning.

2. A detailed map of the botanical garden with the affected plants marked on it has been developed.

3. The most affected plants among the studied were identified. They belong to the orders Fabales, Fagales, Lamiales, Malpighiales, Malvales, Rosales and Sapindales.

4. The most affected plant is Robinia pseudoacacia, which grows a lot outside the NBG, which makes it impossible to use mechanical methods to control the semi-parasite and promotes its spread.

5. No Viscum album was detected on plants of the family Bignoniaceae, Anacardiáceae, Simaroubaceae, Ulmaceae and some others.

Conflict of interest

The authors declare no conflict of interest.

References

1. Drahan, N. V., Yelpitiforov, Ye. M. (2016). Omela avstriiska – nebezpechnyi parazyt sosny zvychainoi. Suchasni tendentsii zberezhennia, vidnovlennia ta zbahachennia riznomanittia botanichnykh sadiv ta dendroparkiv. Bila Tserkva: Dendropark «Oleksandriia», 138–140.

2. Mathiasen, R. L., Nickrent, D. L., Shaw, D. C., Watson, D. M. (2008). Mistletoes: Pathology, Systematics, Ecology, and Management. Plant Disease, 92 (7), 988–1006. doi: http://doi.org/10.1094/pdis-92-7-0988

3. Taran, N. Yu., Batsmanova, L. M., Meleshko, A. O., Ulynets, V. Z., Lukash, O. V. (2007). Fiziolohichne obgruntuvannia metodiv profilaktyky rozpovsiudzhennia ta borotby z omeloiu biloiu u lisoparkovykh landshaftakh. Kyiv: Lenvit, 51.

4. Glatzel, G., Geils, B. W. (2008). Mistletoe ecophysiology: host–parasite interactions. Botany, 87 (1), 10–15.

5. Hinds, T. E., Hawksworth, F. G. (1965). Seed Dispersal Velocity in Four Dwarfmistletoes. Science, 148 (3669), 517–519. doi: http://doi.org/10.1126/science.148.3669.517

6. Bulhakova, T. O. (1969). Omela ta yii roslyny-hospodari v dendroparku «Oleksandriia» AN URSR. Introduktsiia deiakykh ekzotiv i politomichnyi metod yikh vyznachennia. Kyiv: Naukova dumka, 49–50.

7. Hawksworth, F. G., Wiens, D. (1996). Dwarf mistletoes: biology, pathology and systematics. Washington: Agriculture Handbook, 709. USDA Forest Service, 410.

8. Kuznetsov, S. I., Levon, F. M., Klymenko, Yu. A., Pylypchuk, V. F., Shumik, M. I. (2000). Suchasnyi stan ta shliakhy optymizatsii zelenykh nasadzhen v Kyievi. Introduktsiia i zelene budivnytstvo. Bila Tserkva: Mustanh, 90–104.

9. Tübeuf, K. F. (1923). Monographie der Mistel. München und Berlin: R. Oldenbourg, 832. doi: http://doi.org/10.5962/bhl.title.15456

10. Watson, D. M. (2001). Mistletoe – A Keystone Resource in Forests and Woodlands Worldwide. Annual Review of Ecology and Systematics, 32 (1), 219–249. doi: http://doi.org/10.1146/annurev.ecolsys.32.081501.114024

11. Rybalka, I. O., Verheles, Yu. I. (2016). Osoblyvosti poshyrennia omely biloi (Viscum album L.) na terytorii mista Kharkova. Naukovyi visnyk NLTU Ukrainy, 26.7, 145–151.

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Yevhen Yelpitiforov, PhD, Leading Engineer, M. M. Gryshko National Botanical Garden of National Academy of Sciences of Ukraine, Timiryazivska str., 1, Kyiv, Ukraine, 01014
E-mail: elpitiforov@ukr.net

Yuriy Klymenko, Doctor of Agricultural Sciences, Senior Researcher, M. M. Gryshko National Botanical Garden of National Academy of Sciences of Ukraine, Timiryazivska str., 1, Kyiv, Ukraine, 01014
E-mail: klimenko109@ukr.net