

RESEARCH ARTICLE

Preliminary studies of the phytosanitary condition of urban greenery in the city of Kropyvnytskyi (Ukraine)

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The paper deals with the preliminary results of the phytosanitary survey of urban greenery in the city of Kropyvnytskyi. It was established that 26 species of trees and shrubs were affected by diseases and pests during the research period. Studies have shown that diseases and pests of woody plants leaves or needles are more common in park plantings. In street plantings, woody plants are more often affected by stem rot pathogens, while leaves are damaged by leaf miners or mites.

Keywords: Pathogens, Plant diseases, Pests, Woody plants.

Introduction

Problem statement

The function of a powerful natural «green filter» that stabilizes all components of the urban ecosystem is one of the many vital functions of plants in the urban environment. Numerous studies have shown that preserving the conditions of the natural environment in cities that are optimal for human life is possible with a high level of vital condition of urban vegetation. Simultaneously, the protective properties of the plants themselves directly depend on the complex impact of environmental conditions (Dragan, NV., et al., 2018).

The presence of faulty specimens of woody plants damaged by various pathogens in the green spaces of Kropyvnytskyi poses a problem. These specimens often lose their aesthetic appearance and are unable to perform sanitary and environmental functions. Besides, they are sources of diseases and pests. Affected plants threaten the life and health of city residents: they can cause damage to buildings and road surfaces, breakdown of power lines, traffic suspension, etc. (Boiko, TO., 2020). Thus, establishing the phytosanitary state of urban vegetation and preserving the vital state of woody plants is a complex of practical and scientific research.

Materials and Methods

The inventory of entomopests and pathogens of woody plants was carried out on the territory of Kropyvnytskyi during 2022-2023. The surveys were conducted in the city parks and squares (Dendropark, Kovalivskyi Park, Park Kosmonavtiv, Slavy Square, Taras Shevchenko Square and 40 rokiv Peremohy Square), as well as street plantings (Fig. 1).

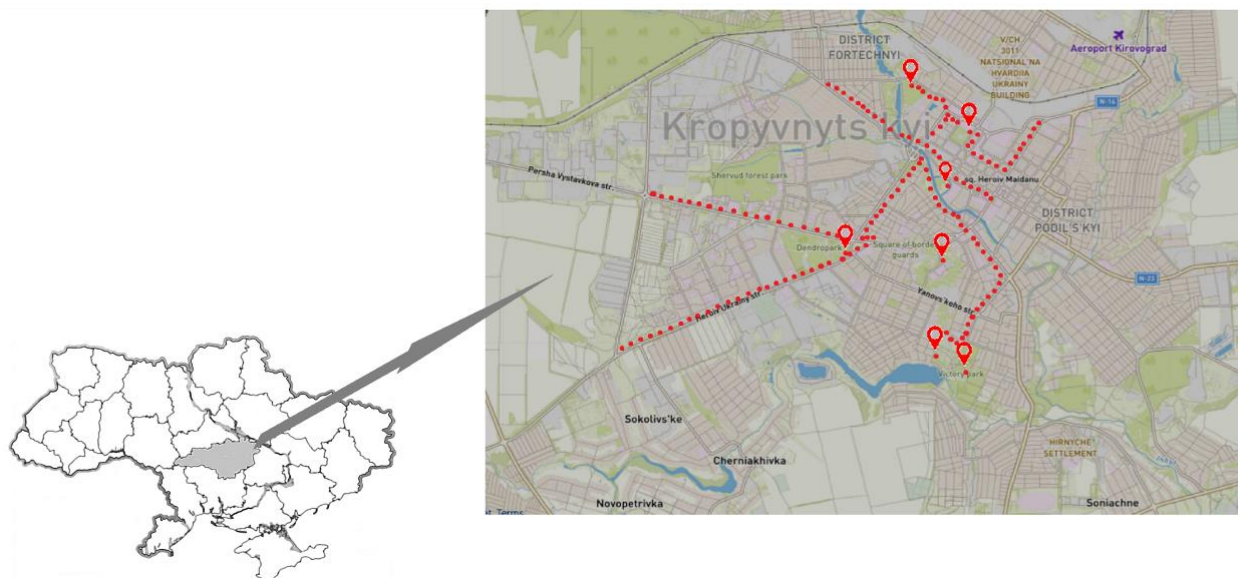


Fig. 1. Survey routes within the city of Kropyvnytskyi.

Diseases and pest damage were diagnosed based on external macroscopic signs on leaves, young shoots, trunks and branches of woody plants. The phytosanitary condition was assessed by visual inspection during expeditionary surveys of parks, squares and street plantings in the city. The material was processed in the laboratory using the standard methods. Pathogenic organisms were identified using identifiers, atlases, scientific publications (Andrianova, TV., et al., 2006; Heluta, VP., et al., 1989; Davydenko, K., et al., 2011; Hamanova, OM., 2007; Holoborodko, KK., et al., 2018; Mattheck, C., 2003; Meshkova, V., et al., 2020; Soika, GRAZYNA., et al., 2013; Tkalenko, A., et al., 2019; Tribel, SO., et al., 2008). Latin names of higher plants are given according to the Checklist (Mosyakin, SL., et al., 1999). For each species, we present information about the substrate, its spatial growth patterns, and the corresponding frequency of occurrence in the study area categorized as: very rare-1-3 locations, rare-up to 4-8 locations, sporadic-9-15 locations, frequent-16-50 locations, common-more than 50 (Bairak, O., et al., 1998; Boiko, TO., et al., 2018).

Results

The sanitary condition of the woody plantings in Kropyvnytskyi can be generally characterized as satisfactory. However, preliminary surveys have unveiled instances where certain specimens of tree species are afflicted by pests, diseases, or non-infectious injuries. There are 170 species of woody plants in Kropyvnytskyi (Arkuschina, AF., et al., 2003; Arkuschina, AF., et al., 2010). It was found that during the investigation period 26 species of trees and shrubs were affected by diseases and pests.

Pathogens found on woody plants in the green spaces of Kropyvnytskyi:

Bjerkandera adusta (Willd.) P.Karst. causes white rot in *Populus nigra* L., *Tilia cordata* Mill., *Ulmus laevis* Pall., *Salix alba* L., is also found on stumps and trunks of dead specimens. It is rare in park plantations.

Coriolus pubescens (Schumach.) Quel. causes mixed rot of *Acer pseudoplatanus* L., *Salix alba* L. та *Fraxinus excelsior* L. mostly on weakened or dead specimens. It is rare in parks and squares of the city.

Diplodia juniperi West. causes necrosis on trunks and branches of *Juniperus virginiana* L. in the city street plantings. It occurs sporadically.

Erysiphe alphitoides (Griffon & Maubl.) U. Braun & S. Takam. pathogen of leaf powdery mildew of *Quercus robur* L., occurs in all types of plantings.

Flammulina velutipes (Curtis) P. Karst. on the trunks of *Ailanthus altissima* (Mill.) Swingle occurs very rarely in street plantings.

Fomes fomentarius (L.) Fr. on trunks and branches of *Acer platanoides* L. and *Fraxinus excelsior* in parks and squares of the city.

Laetiporus sulphureus (Bull.) Murrill-on trunks of *Populus alba* L., *Robinia pseudoacacia* L., as well as on stumps. It causes central brown prismatic rot. It occurs sporadically in all types of plantings.

Lophodermium juniperinum (Fr.) De Not. causes yellowing and death of needles (shute) in *Juniperus sabina* L. та *Juniperus virginiana* L. It occurs frequently in all types of plantings.

Microsphaera berberidis (DC) Lev., pathogen of leaf powdery mildew of *Berberis thunbergii* DC., sporadically, in all types of plantings.

Lophodermium pinastri (Schrad.) Chevall causes yellowing and death of needles (shute) in *Pinus pallasiana* D. Don. It occurs sporadically in all types of plantings.

Monilia cinerea Bonord. on branches of *Cerasus vulgaris* Mill. and *Cerasus avium* (L.) Moench. It occurs sporadically in all types of plantings.

Phellinus igniarius (L.) Quel. on trunks and branches of *Acer pseudoplatanus* L., *Aesculus hippocastanum* L., *Cerasus vulgaris* Mill. It is rare in park and street plantings.

Phellinus pomaceus (Pers.) Maire on branches and trunks of *Cerasus vulgaris* Mill., *Cerasus avium* (L.) Moench, *Armeniaca vulgaris* Lam. It occurs frequently in all types of plantings.

Pleurotus ostreatus (Jacq. Ex Fr.) P.Kumm. on trunks of *Acer platanoides*, is rare in park and street plantings.

Rhytisma acerinum (Pers.) Fr. on leaves of *Acer platanoides* L., in park plantings, the occurrence is sporadic.

Sawadaea bicornis (Wallr.) Homma-powdery mildew pathogen found on leaves of *Acer campestre* L., *Acer platanoides*, *Acer platanoides* 'Royal Red'. It occurs frequently in all types of plantings.

Schizophyllum commune Fr. on dead branches and trunks of *Armeniaca vulgaris*, *Tilia cordata*, *Acer pseudoplatanus*. Mostly on weakened or dead specimens. It occurs frequently in all types of plantings.

Trametes hirsute (Wulfen) Lloyd—on stumps and dead branches of *Cerasus vulgaris* Mill., *Cerasus avium* (L.) Moench, *Armeniaca vulgaris*. It occurs sporadically in all types of plantations.

Trametes ochracea (Pers.) Gilb. & Ryvarde—on stumps and dead branches of *Ulmus laevis* Pall., *Acer platanoides*. It is rare in park plantings.

Trametes versicolor (L.) Lloyd—mainly occurs on dead wood, fallen branches and stumps of *Tilia cordata* and *Ulmus laevis*. Occasionally occurs in park plantings.

Verticillium alboatrum Reinke & Berthold—trunks and branches lesion of *Catalpa speciosa* (Warder ex Barney) Warder ex Engelm., very rare in street plantings.

Viscum album L.—branches lesion of *Acer pseudoplatanus*, *Fraxinus excelsior*, *Tilia cordata*, *Populus alba*. It occurs frequently, in all types of urban plantings.

Insect pests found on woody plants in green spaces of Kropyvnytskyi

Aceria heteronyx (Nalepa, 1891)—affects the leaves of *Acer platanoides*. It is found very rarely in street plantings.

Cameraria ohridella Deschka & Dimic, 1986 *Aesculus hippocastanum* L. A common species, on plants in all types of plantings.

Myzus cerasi Fabricius, 1775—affects the leaves of *Cerasus vulgaris* and *Cerasus avium*. It is found rarely on plants in all types of plantings.

Liosomaphis berberidis (Kalt.) affects the leaves of *Berberis thunbergii* DC. It is often found on the plants in all types of plantings.

Cydalima perspectalis (Walker, 1859)—affects leaves and young shoots of *Buxus sempervirens* L. It is found rarely on the plants of the street plantings.

Eriophyes tristriatus var. *erineus* (Nal., 1891) affects leaves of *Juglans regia* L. It is often found on the plants in all types of plantings.

Dasyneura fraxini Kieff. affects leaves of *Fraxinus excelsior*. It is rarely found on the plants in all types of plantings.

Parectopa robiniella Clemens, 186—affects leaves of *Robinia pseudoacacia*. It is often found on the plants in all types of plantings.

Neuroterus albipes Schench.—affects leaves of *Quercus robur*. It is often found on the plants in the park plantings.

Hyphantria cunea (Drury, 1773)—affects leaves of *Morus alba*, *Acer campestre*, *Juglans regia*.

Cynips quercusfolii Linnaeus, 1758—affects leaves of *Quercus robur*. It is often found on the plants in all types of plantings.

Corythucha arcuata (Say, 1832)—affects leaves of *Quercus robur*. It is found rarely on the plants in park plantings.

Typloctonus aceri (Collyer, 1957)—affects leaves of *Tilia cordata*. Found very rarely on the plants in street plantings.

Eriophyes tiliae Pagenstecher, 1857—affects leaves of *Tilia cordata* and *Tilia platyphyllos* Scop. It is often found in thickened plantings, in the lower part of plant crowns.

Euseius finlandicus (Oudemans, 1915)—affects the needles of *Thuja occidentalis* L. and *Juniperus sabina* L. is rarely found on the plants in all types of plantings.

Carulaspis juniperi (Bouche, 1851)—affects the needles of *Juniperus virginiana* L.. It is found often on the plants in all types of plantings.

Kampimodromus aberrans, Ouderman, 1930—affects the leaves of *Ulmus laevis*. It is found rarely on the plants in all types of plantings.

Macrosiphum rosae (Linnaeus, 1758)—affects leaves and young shoots of *Rosa* L. It is found rarely, in the city parks and squares

Discussion

The development of pathogenic organisms leads to a decrease in the viability and decorative effect of plants in different types of plantings (Shepeliuk, M., et al., 2019).

The distribution of *Viscum album* on the territory of the city of Kropyvnytskyi has been analyzed. There were noted individual lesions on *Fraxinus excelsior*, *Acer pseudoplatanus*, *Tilia cordata*, *Populus alba*. This semi-parasite of woody plants most often affects the tree specimens growing along roads. However, isolated lesions also occur in the park plantings. Specimens affected by *Viscum album* showed a decrease in viability, drying out of branches in areas with mistletoe semi-shrub growth. The city's municipal services monitor the spread of this semi-parasite and conduct sanitary felling of affected plants.

The most common of the leaf diseases is powdery mildew. The pathogens of this disease affect a wide range of woody plants (*Quercus robur*, *Acer platanoides*, *Acer campestre*, *Berberis thunbergii*). Often, the damage to plants by this disease results in a decline in the decorative effect of plants, and their weakening is accompanied by various other diseases and pests.

A leaf marginal necrosis is common in woody plants of street plantings. It is a non-infectious disease caused by unfavorable environmental conditions, drought, thickening and pollution of soil and air (Holoborodko, KK., et al., 2016). Necrotic spots typically develop along the edges of leaf blades and may cover a substantial portion of the leaf. The leaves look burnt and deformed.

The specimens of *Robinia pseudoacacia*, *Fraxinus excelsior*, *Populus alba*, *Ulmus laevis*, growing in dense plantings in parks and squares, in plantings along the roads can have dried tops; in some places absolutely dried specimens occur.

Necrotic and vascular diseases of woody plants are caused by fungi of the genera *Meruliaceae* P. Karst., *Polyporaceae* Fr. ex Corda, *Hymenochaetaceae* Donk, *Physalacriaceae* Corner, *Schizophyllaceae* Qué. Affected plants occur in all types of plantings.

The range of pests that affect woody plants in the green areas of Kropyvnytskyi is quite diverse. Under certain conditions, they can cause localized hotspots of insect mass reproduction and damage urban green plantings.

One of the most harmful insect pests in the studied conditions is the insect miner *Cameraria ohridella* which has been affecting the leaves of *Aesculus hippocastanum* for a number of years; the damage is epiphytotic throughout Ukraine. In 2023, necrotic spots on certain specimens extended to cover 100% of the leaf blade, resulting in dried-up leaves that looked burnt.

Widespread mites that occur in all types of plantings are *Aceria heteronyx*, *Eriophyes tristriatus* var. *erineus*, *Typhloctonus aceris*, *Euseius finlandicus*. In damaged specimens, the leaves curl and lose their turgor.

In the green spaces of Kropyvnytskyi, during the study period, we noted *Hyphantria cunea*, that affects *Morus alba*, *Juglans regia* та *Acer campestre*. During the study period, plant damage was not widespread.

Single specimens of *Buxus sempervirens* L. were affected by the pest *Cydalima perspectalis* during the study period. Several localities of damage were noted in the city. In the neighboring southern regions, the damage of plantings by *Buxus sempervirens* over the past 5-7 years has been epiphytotic. Therefore, one should expect outbreaks of massive damage to *Buxus* by this insect pest in the coming years.

On the leaves of *Quercus robur* we found isolated foci of *Corythucha arcuata*, an invasive and quite harmful oak pest. This species causes significant damage to oak plantings in Europe. Therefore, the city's municipal services need to monitor the spread of this species.

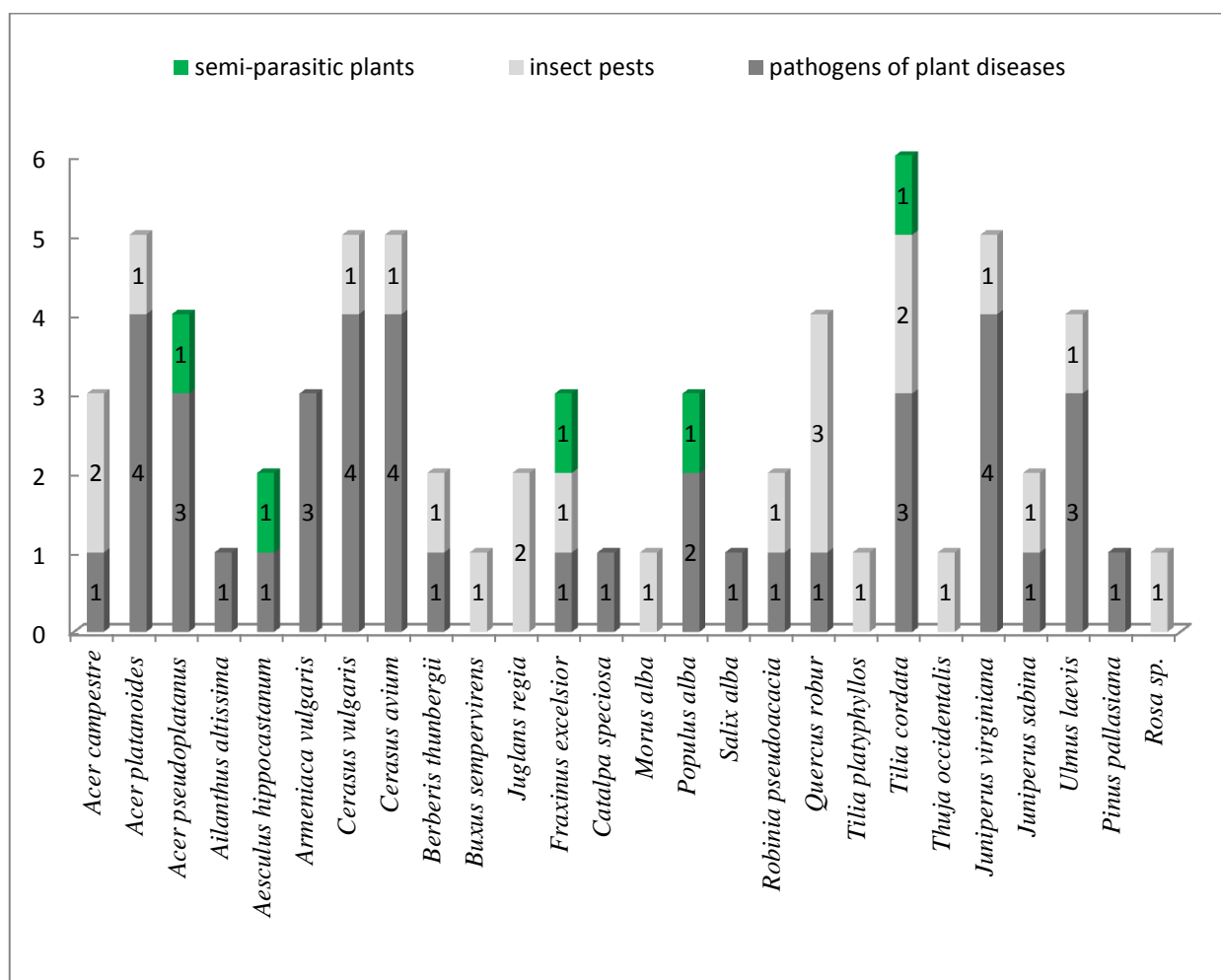


Fig. 2. The range of pests and diseases of tree species in Kropyvnytskyi.

Our research allowed to establish that 26 species of woody plants in Kropyvnytskyi are affected by diseases and pests (fig.2). *Tilia cordata*, *Acer Acer platanoides*, *Juniperus virginiana*, *Cerasus vulgaris* and *Cerasus avium* are affected by the widest range of pathogens.

However, through evaluating the type and magnitude of damage impacting the overall health of plants and their decorative effect, the most vulnerable to the activity of phytopathogens and entomopests were *Aesculus hippocastanum*, *Acer pseudoplatanus*, *Populus alba*, *Tilia cordata*, *Berberis thunbergii*.

The life condition of green plantings within the research area is assessed as satisfactory. Nevertheless, some individual specimens in street plantings (*Aesculus hippocastanum*, *Robinia pseudoacacia*, *Acer platanoides*, *Ailanthus altissima*, *Tilia cordata*, etc.) and in park plantings have stunted growth. Such plants often require either sanitary felling or complete removal.

Studies have shown that various types of plantings differ in the species composition of pathogens and the degree of individual pathogens development. For example, diseases and pests of woody plants leaves or needles are more common in park plantings. In street plantings, woody plants are more often affected by stem rot pathogens, while plant leaves are damaged by insect miners or mites (Kolodochka, L.; Tsilyurik, A.V., 2008)

The emergence of lesions and diseases is facilitated by the overripe age of plantings, excessive recreational load on green areas, and irregularity of qualified care for them. Therefore, tree forming and selective sanitary felling is recommended in the research area. Street plantings should be watered in the hot season, which will improve the phytosanitary condition of green plantings in Kropyvnytskyi.

Conclusion

To form plantings resilient to phytopathogens, it is necessary to propose a new system of their creation, which will be based on increasing the plant resistance to the combined effects of abiotic and biotic factors. The main recommendations can be summarised as follows:

- Create mixed plantings, including evergreens and deciduous plants. Ensure the alternation of seedlings of different ages to create multi-tiered plantings.
- Gradual replacement of low-resistant tree species with species resistant to pathogens.
- The selection of plants for parks and roadside plantings should take into account their durability, and resistance to gas, dust, drought and frost.
- When creating new plantings, it is necessary to ensure the alternation of open and closed spaces occupied by tree plantings to provide ventilation of territories around industrial enterprises, motorways and residential areas.
- Use of seasonally appropriate agricultural techniques that will increase the resistance properties of plants in the urban ecosystem.
- Systematically monitor the development of the most aggressive pests and pathogens.

Author's Contribution

Tetiana Boiko: collection and analysis of pathogenic organisms, analysis of the obtained results.

Pavlo Boiko: overview of the problem, analysis of the obtained results, graphic materials.

Acknowledgement

None.

Conflict of Interest

The authors declare no conflict of interest.

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