

THE MOST IMPORTANT FUNGAL DISEASES OF TREES AND SHRUBS IN GREEN PLANTINGS OF MOSCOW AND MOSCOW SUBURBS

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Abstract

The present paper presents information on the species composition, features of distribution and harmfulness of dendrotrophic pathogenic fungi, based on long-term observations on the health status and diseases in different types of urban plantings in Moscow and some towns of Moscow suburbs. The survey revealed more than 300 species of pathogenic fungi causing various diseases on roots, trunks, branches, leaves and needles in more than 70 species of coniferous and deciduous trees and shrubs, including a lot of introduced woody plants. Special attention is given to the diseases decreasing durability, protective and aesthetic functions of urban plantings.

Key words: fungi, diseases, woody plants, urban plantings, Moscow, Moscow suburbs, Russia.

Introduction

Green plantings are an integral part of urban planning structure and play an important role in improvement of the urban environment. The green fund of Moscow represents a set of green areas of different type and purpose, including plantings along streets and highways, plantings in yards, squares, parkways, parks, gardens, and territories of 39 amenity forests within the city boundaries.

Development of green plantings of Moscow and its suburbs proceeds under intensive influence of adverse anthropogenic and natural factors. By the end of the last

decade in connection with growing anthropogenic influence on the status of city environment and deterioration of the ecological situation in Moscow, an imminent need arose for reestablishment and increase of resistance, ornamental, sanitary-and-hygienic and other diverse properties of green areas of the city. Following an order of the Moscow Government, a large-scale work began in 1997 within the framework of the general city program of monitoring of the condition of green plantings in Moscow (Mozolevskaya 1998, Yakubov 2001, 2005). Problems which were stated before forest pathologists first of all, consisted in estimation of the sanitary condition of ur-

ban plantings and the level of diseases and pests. Forest and ornamental nurseries were also surveyed, from which the planting material was delivered to Moscow and Moscow suburbs. The study period covered 10 years.

The paper presents basic results of studying species composition of phytopathogenic fungi and their role in worsening the urban plantings condition and decrease of their ornamental properties.

Material and Methods

Field studies were carried out with the use of methods of forest pathological inspections developed by the Department of ecology and protection of forest of the Moscow State Forest University (Mozolevskaya et al. 1984, Vorontsov et al. 1991). The sanitary condition of plantings and the level of diseases were estimated in the sample areas established in different types of urban plantings in Moscow and some towns of Moscow suburbs, including Mytishchy and Korolev. At the same time samples of affected parts of plants were selected for investigation in laboratory conditions. Studying of species composition of fungi was carried out also on routes. The Russian and foreign literature was used for identification of species of fungi.

Results and Discussion

As a result of long-term observation of different urban plantings types in Moscow and some towns of Moscow suburbs more than 500 species of dendrotrophic fungi were identified, from which 327

species were pathogenic fungi causing various diseases of roots, trunks, branches, leaves and needles in more than 70 species of coniferous and broad-leaved trees and shrubs (Sokolova et al. 2006, Kolganikhina and Sokolova 2009, Sokolova and Kolganikhina 2009). Among them there was a group of the most active pathogens, causing essential harm to woody plants, which deserved special attention.

The most widespread diseases of leaves in urban plantings were powdery mildews, leaf spots and leaf rusts. Oak (*Quercus robur* L., pathogen *Microsphaera alphitoides* Griffon et Maubl.), maple (*Acer platanoides* L. and *A. ginnala* Maxim., affected mainly by *Sawadaea tulasnei* (Fuck.) Homma; *A. negundo* L. and *A. tataricum* L., affected mainly by *Sawadaea bicornis* (Wallr.:Fr.) Miyabe), and birch (*Betula pendula* Roth., pathogen *Phyllactinia guttata* (Wallr.:Fr.) Lév.) were the species most strongly affected by powdery mildews. The powdery mildew of horse-chestnut (*Aesculus hippocastanum* L.) caused by *Uncinula flexuosa* (Peck.) U. Braun was found to a great extent in some plantings. Some shrub species were also strongly affected by powdery mildew: *Caragana arborescens* Lam. – by *Microsphaera palczewskii* Jacz., *Berberis vulgaris* L. – by *Microsphaera berberidis* (DC) Lév., *Lonicera tatarica* L. – by *Microsphaera loniceræ* (DC) Wint. and also species of rose (*Rosa* L.) – by *Sphaerotheca pannosa* (Wallr. ex Fr.) Lév. var. *rosae* Woronich. The listed species of woody plants were affected by powdery mildews each year. Foliage diseases resulted to a great extent in almost full or sometimes full loss of ornamental properties of trees and shrubs and decrease of their protective functions.

Leaf spot agents as *Discula umbrinella* (Berk. ex Broome) Sutton affecting Lime and Oak, *Discula betulina* (Westend.) Arx affecting Birch, *Phyllosticta sphaeropsoides* Ellis et Evern. affecting Horse-chestnut are widespread in plantings in Moscow and Moscow suburbs. In some years *Marssonina populi* Sacc. and *Septoria populi* Desm. developed massively on the leaves of poplars. *Dothidella ulmi* (Duv.) Wint. was also found to a great extent on the leaves of elms (mainly *Ulmus laevis* Pall. and *U. pumila* L.) in certain years. The leaf spot of maple (mainly *A. platanoides*) caused by *Rhytisma acerinum* Fr. was often observed on young plants in amenity forests and plantings in yards. The following leaf spot agents were widely spread on shrub species: *Sphaceloma symphoricarpi* Barrus. ex Horsfall. affecting *Symphoricarpos albus* (L.) Blake, *Marssonina rosae* (Lib.) Died. affecting roses, *Phyllosticta michailowskoensis* Elenk. affecting species of hawthorn (*Crataegus* L.). Some diseases of this category resulted in premature defoliation which entailed partial or full loss of ornamental properties and resulted in weakening of plants. So, for example, during mass development of leaf spots on Poplar, Oak and Birch the trees lost up to 50% of foliage already in the middle of the summer and that resulted not only in full loss of their ornamental properties, but also in decrease of their protective functions.

The leaf rust on Poplar (mainly *Populus nigra* L. and *P. balsamifera* L.) caused by *Melampsora larici-populina* Kleb. and *M. allii-populina* Kleb. was recorded year in the plantings in Moscow and its suburbs. Sometimes the leaf rust on Birch caused by *Melampsoridium betulinum* Kleb. was observed to a great extent. The leaf rust of *Caragana arborescens* caused

by *Uromyces laburni* (DC) Otth. and on the Rose species (especially on *R. canina* L.) caused by *Phragmidium mucronatum* (Pers.:Pers.) Schlech. periodically developed quite strongly in some plantings. In the years of mass development these diseases resulted in premature defoliation, decrease of ornamental properties and weakening of plants.

Diseases of needles were mostly spread and had the greatest importance for young plants in various categories of urban plantings. *Lophodermium* needle cast caused by *Lophodermium pinastri* Chev., which frequently serves as the indicator of weakening of plants, is the most widespread disease on needles of different pine species.

For the last 20 years agents of dangerous diseases in needles not found before have been registered in the Moscow region: *Cyclaneusma minus* (Butin) Di Cosmo, Peredo & Minter, *Dothistroma septospora* (Dorog.) Morelet and *Brunchorstia pinea* (Karst.) Höhn. Currently these pathogenic species do not have wide distribution in the Moscow region. They were recorded, basically, in some private possession, while the level of their development is low. However, all they possess potential danger to plantings of Moscow.

In urban plantings and in private possession *C. minus*, causing needle yellowing of pine (*Cyclaneusma* needle cast of pine) has been found quite often on a few species of pine, including *Pinus mugo* Turra, *P. sibirica* Du Tour and *P. nigra* Arn. It is known that it occurs worldwide and affects more than 10 pine species. *C. minus* is characterized by high parasitic activity and affects needles of the trees, which do not have signs of weakening. The disease development results to a great extent in thinning the crowns,

weakening of trees and decreasing their ornamental properties.

Now *Dothistroma septospora*, causing needle red spot of pine (*Dothistroma* pine needle blight or red band needle blight), is registered in many countries of Europe and America, in some countries of South-east Asia and Africa, and in Australia. On the territory of the former USSR this disease was reported from Georgia and Kazakhstan. This fungus affects many pine species, including *P. sylvestris* L., *P. pallasiana* D. Don and others. In the Moscow region it was found on needles of *P. nigra*. *D. septospora* is characterized by high parasitic activity and it is the reason of premature needle dieback and defoliation. The disease results in mass weakening of young plants and decrease of their ornamental properties, and less often destroys them.

Gremmeniella shoot canker caused by *Gremmeniella abietina* (Lagerb.) M. Morelet (anamorph: *Brunchorstia pinea* (Karst.) Höhn.) can affect species of pine, spruce (*Picea* A. Dietr.), fir (*Abies* Mill.) and larch (*Larix* Mill.). It is known from the Scandinavian countries and Baltic States. On the territory of Russia it was registered on Kola Peninsula and in the Volga region. Once this fungus was mass recorded on *Pinus sibirica* in one of nurseries in the Moscow region. The anamorph stage (*Brunchorstia pinea*) was recorded only on needles (not on shoots) of *Pinus sylvestris* in Moscow and Moscow suburbs.

Needles of different spruce species are frequently affected by *Lophodermium* needle cast caused by *Lirula macrosporum* (R. Hartig) Darker. Recently the Rhizosphaera needle cast caused by *Rhizosphaera kalkhofii* Bubak. developed quite strongly on *Picea pungens* Engelm. and *Pseudotsuga menziesii* (Mirb.) Franco

in some places in Moscow and Moscow suburbs.

Lophodermium needle cast of junipers (*Juniperus* L.) caused by *Lophodermium juniperinum* (Fr.) de Not occurs very frequently on different juniper species. *Pestalotiopsis funerea* (Desm.) Steyaert often develops on needles and branches of the species (including *J. sabina* L., *J. virginiana* L.) and thuja (*Thuja occidentalis* L.). More often this fungus affects the plants injured by frosts or predisposed to disease due to growing in adverse conditions.

Diseases of branches, trunks and roots are the most important group of diseases of woody plants in the city plantings. The Dutch elm disease caused by *Ophiostoma ulmi* (Buisson) Nannf. occurs in all areas of Moscow and towns of Moscow suburbs. It affects different species of elm, including *Ulmus laevis*, *U. glabra* Huds., *U. pumila*. For the last 20 years this disease has resulted in disappearance of the whole plantations of this tree species. The increase of hotbeds of the Dutch elm disease in the sharp form has recently been observed.

Among dieback diseases, many of which are dieback and canker, *Cytospora* diebacks are widespread on different deciduous tree species, especially on Poplar, caused by *Cytospora chrysosperma* (Pers.) Fr. and *C. leucostoma* (Pers.) Sacc. and also on Lime, Mountain ash (*Sorbus* L.) and Hawthorn, caused by *C. leucosperma* (Pers.) Fr. The disease was frequently recorded on linden and poplar growing in adverse conditions.

Nectria (*Tubercularia*) canker and dieback caused by *Nectria cinnabarina* (Tode: Fr.) Fr. (anamorph: *Tubercularia vulgaris* Tode) occurred in many deciduous tree species. In Moscow it represents

the greatest danger for young plantings, especially horse-chestnut, mountain ash and linden. *Colpoma* dieback caused by *Colpoma quercina* (Pers.) Wallr. and *Vuilleminia* decay caused by *Vuilleminia comedens* Maire resulted in weakening of plants in young plantings of oak in some places of Moscow.

Among dieback diseases of coniferous tree species it is necessary to mention *Sphaeropsis sapinea* (Fr.) Dyko & B. Sutton. This pathogen develops not only on branches but also on needles of pine.

Thyrostroma canker and dieback caused by *Thyrostroma compactum* (Sacc.) Höhn. affected different species of Lime and Elm (especially strongly *Tilia cordata* Mill. and *Ulmus pumila*) in Moscow. The fungus was registered for the first time in 1976 in the Moscow Region on the branches of a Lime tree. For the next 10 years it was found in different regions of the country in natural and urban plantings.

In plantings of Moscow and Moscow suburbs the disease was registered at the beginning of 1980s. From the middle of 1980s till now it has been spread in all categories of plantings of Moscow and has caused mass weakening, decrease of ornamental properties and dieback of Lime trees. Therefore, mass cuttings of Lime were carried out, especially along highways, and also in the street and yard plantings. All this resulted in reconstruction of some part of plantings in Moscow. Though the disease was registered in different types of urban plantings, in the most polluted environmental conditions (along large highways) the fungal stroma did not develop, but under favorable conditions the signs of the disease were revealed more precisely. This was probably due to the fungicide action of environmen-

tal pollutants. The disease affects different age trees of Lime, including nurseries. In the stands of amenity forests the disease affected both adult trees and understory.

Perennial *Neonectria* canker of deciduous tree species caused by *Neonectria galligena* (Bres.) Rossman & Samuels frequently occurred in different categories of urban plantations. Most frequently it affects Lime, Maple and Ash. Black *Hypoxylon* canker of Aspen and Poplar caused by *Hypoxylon mammatum* (Wahl.) J.H. Miller occurred seldom; more frequently it developed on *Populus alba* L. and *P. tremula* L. Black *Botryosphaeria* canker of apple-tree (*Malus domestica* Borkh.) caused by *Botryosphaeria obtusa* (Schwein.) Shoemaker (anamorph: *Sphaeropsis malorum* Berk.) represents danger to old apple-tree plantings. Quite often the agent causing this disease and that of *Cytospora* dieback, caused by *Cytospora schulzeri* Sacc. & P. Syd. developed simultaneously on the large skeletal branches and trunks of apple-trees.

The pitch blister rust canker affecting trunks of *Pinus sylvestris* caused by *Cronartium flaccidum* (Alb. et Schwein.) Wint. was widely spread. It occurred both in amenity forest, and on planted trees and shrubs territories of the city, with some remnants of old trees from previous plantings. Stem rust of pine caused by *Cronartium ribicola* Dietr. affected trunks and branches of *P. sibirica* and *P. strobus* L., which are sometimes used in plantations near offices.

Among the agents of root rots *Heterobasidion annosum* (Fr.: Fr.) Bref., *Armillaria* species complex (*A. mellea* (Vahl.: Fr.) Kummer is the type species), were particularly frequently recorded in the coniferous plantations, and *Phaeolus schweinitzii* (Fr.: Fr.) Pat. occurred in the

stands of amenity forests. The *Armillaria* species complex, *Phaeolus schweinitzii* and *Ganoderma applanatum* (Pers.) Pat. were most frequently recorded in the street plantings and in other parts of the city. In different categories of plantings *Armillaria* species complex affected trees preliminary weakened by various factors of technogenic nature.

Of the agents of trunk rots in coniferous tree species the fungi *Phellinus pini* (Thore ex Fr.) Pil., *Ph. chrysoloma* (Fr.) Donk, *Onnia triqueter* (Lentz.: Fr.) Imaz. Per S. Ito were widely spread in the stands of amenity forests. The most frequent there were *Phellinus igniarius* (L. et Fr.) Quel., *Fomes fomentarius* (L.) Will., *Polyporus squamosus* (Huds. ex F.) Fr., *Laetiporus sulphureus* (Bull.: Fr.) Murrill, *Pholiota adiposa* Fr., *Bjerkandera adusta* (Willd.: Fr.) P. Karst., *Chondrostereum purpureum* (Fr.) Pouz. and others, attacking deciduous tree species in all types of green plantings.

Root and trunk decays represent the greatest danger for street and yard plantings, squares, parkways and other planted trees and shrubs territories of city. These diseases cause windfall and wind-break with squally and gale-force winds and therefore represent danger to people, buildings and constructions.

Conclusions

The study demonstrated that fungal diseases are one of the most important factors lowering durability, protective and aesthetic functions of urban plantings.

Infectious diseases penetrate into plantings in Moscow and Moscow suburbs with the planting material from the Russian and foreign forest and ornamental nurser-

ies. First of all, the following factors contribute to the wide circulation of infectious diseases agents in urban plantings: the insufficient control over the planting material imported from other regions of Russia, local nurseries and from abroad; absence of appropriate conditions of keeping of the planting material in nurseries, violation of the regulations while transporting and planting, which results in worsening of plant conditions and decreasing of their disease resistance; discrepancy in climate types to growing conditions; delayed destruction of sources of infection; influence of the urban environment.

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