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Phytopathogenic fungi of *Caragana arborescens* Lam., growing in the city Karaganda

The article presents the results of the determination of powdery-mildews fungi and rust fungi of shrub plantings growing on the streets, squares and parks of the city of Karaganda. The article presents data on the species composition of phytopathogenic fungi, where the host-plant is the *Caragana arborescens* Lam., growing in the city of Karaganda. Theoretical and practical information on methods for determining phytopathogenic fungi by fruit bodies, appendages, asci and ascospores has been collected by us. Phytopathogenic fungi are directly dependent on their host-plant, the conditions of development and the duration of the period of vegetation. Timely study of the condition of the plants used for greening the city, identification of diseases, level of their development, distribution, biology in accordance with the climatic conditions of the region is the basis for preventing the spread of these harmful organisms, carrying out effective control measures against them. For the first time in this region, the shrub *Caragana arborescens* Lam. is a host-plant for such species of phytopathogenic fungi as: powdery-mildews fungi *Microsphaera caraganae* L., rust fungi *Uromyces cytisi* J. Schröt.

Keywords: industrial city, shrub plantings, *Caragana arborescens* Lam., phytopathogenic fungi, powdery-mildews fungi, rust fungi, *Microsphaera caraganae* L., *Uromyces cytisi* J. Schröt.

Introduction

Karaganda region is the largest area in terms of territory and industrial potential, which is rich in minerals and raw materials, and up to 30 % of the entire mining industry of the country is concentrated on its territory. Karaganda is one of the largest industrial, economic, scientific and cultural cities of Kazakhstan. There are many factories operating here and the largest coal production enterprises are concentrated: Agat-Service LLP, Kazakhstan Invest Comir JSC, Kazakhmys Corporation LLP, MMC Kazpolymetal LLP, Complect Karaganda LLP. Metallurgical, mining, chemical industrial enterprises are located in Karaganda [1].

Currently, in cities it is necessary not only to take care of green plantations, but also to protect them from various diseases. Microscopic pathogenic fungi predominate among them, and these harmful organisms not only reduce the pigmentation of green plantations, but also worsen the operational capabilities of growing trees and shrubs, shorten their age, and reduce resistance to adverse environmental conditions. They are also harmful to ecosystems in immediate proximity of industrial centers. Among the pathogenic micromycetes affecting the leaves of trees and shrubs used in urban landscaping, powdery mildew and rust fungi account for a significant proportion [2].

The purpose of the scientific article is to determine and analyze the species composition of phytopathogenic fungi of the *Caragana arborescens* Lam. species growing in the city of Karaganda.

The composition of phytopathogenic fungi is analyzed, the microflora of green plantations of the city of Karaganda is comparatively studied.

C. arborescens is a small tree or shrub, 3 to 7 meters high, trunks can reach up to 18 cm in diameter. In our country, it grows mainly in Eastern and Central Kazakhstan. The leaves consist of 4-7 pairs, large and long, which reach 10 cm, inverse-ovoid, petioles densely covered with hairs. The leaves change color during the vegetative period, in spring — bright green, in autumn — a richer green and yellow colors appear. Blooms after full leafing. The flowers are yellow, assembled in bunches of 2-5, *C. arborescens* blooms from May to June, for two weeks. The fruits are brown, narrow, linear-cylindrical beans [3].

Powdery-mildews fungi are a class of fungi of the *Ascomycetes* phylum, which includes 13 genera, about 500 species. These are obligate parasites of plants that cause the disease — powdery mildew. Their mycelium grows on the surface of leaves, stems and fruits in the form of a white coating. At the time of the vegetation period, new plants are infected by conidia, of which several generations are formed only during the summer. They get on the leaves or other organs of susceptible plants, germinate and cause their infection.

A mycelium develops on the surface of infected organs, and on it — conidiophores with conidia (usually several pieces) arranged in chains. At the end of the growing season, the marsupial stage of closed spherical fruit bodies (chasmotecia) with a diameter of up to 1,5 mm with appendages develops. After overwintering on fallen leaves, the spores in the ascospores of chasmotecia ripen and provide primary infection of plants. Overwintering with mycelium is possible when it penetrates into dormant buds. In the spring, the shell is torn and asci with ascospores are poured out, which infect plants [4].

Rust fungi are an order of fungi included in the phylum Basidiomycetes, which unites species of obligate fungi that parasitize higher plants. It has 1800 species of fungi. The species can be: multi-host (they develop on different feeding plants), single-host (the development cycle takes place on one plant). Causes infection in plants — in the form of spots and lines of rusty color. The spore-bearing stage of rust fungi development occurs on the leaves and stems of plants. Rusty-brown spots form on infected areas, which ripen and dry out over the summer, after which cracks form on them, through which spores (uredospores) poured out and then easily spread to neighboring plants with the help of wind. Uredospores, penetrating into another plant, germinate and form mycelium. In autumn, instead of rusty-yellow spots, darker spots appear — these are winter spores of teleitospores, which will protect the spores in winter [5].

Experimental

To determine and identify the family, genus, species and conduct a systematic analysis of phytopathogenic fungi, the finder-reference book “Flora of spore plants of Kazakhstan”, Vol. 1 “Rust fungi”, Volume 3 “Powdery Mildew fungi” was used by us [6, 7].

The objects of research are parks, squares, streets of the city of Karaganda. The research material were chosen leaves of the *Caragana arborescens* Lam. with plaques, pustules, spots.

Collection of material (herbarium of leaves) for research, which was carried out during the vegetation period (May-July, September-October) of shrubby plants in the city of Karaganda in parks (Central Park, Ethnopark named after the 10th Anniversary of Independence of Kazakhstan, Victory Park), squares (along Stroiteley Avenue), along Nazarbayev, University and others streets.

The primary work was carried out in the Biotechnology laboratory of the Innovative Eurasian University, where work was carried out on visual examination and identification of fungal species on a binocular microscope. At this stage, host-plants and some types of powdery mildew fungi were identified. To determine powdery mildew fungi, preparations were made and looked under a microscope according to the method of I.I. Zhuravlev (1979) — determination of phytopathogenic fungi by fruit bodies, appendages, ascospores and spores.

Further more detailed work was carried out in Turkey, Aydin Adnan Menderes University in the Laboratory of Microbial Biotechnology, where looked under the SopTop binocular microscope. And in the Tarbyomer laboratory, where images from the Olympus DP72 microscope were displayed on a computer using the LabSens program, photographs of fungi that affected the leaves were taken.

To determine rust fungi, used the following method:

- Breeding ground based on Potato Dextrose agar (PDA) and water agar were prepared for the cultivation of underdeveloped fungi. For this:
 - Cut out pieces of leaves with a scalpel from damaged places on herbariums of leaves and place them in bulbs;
 - Pour 20 ml of NaCl₂ solution into each bulb and wait for 2 minutes, then cover the flask with gauze and pour out the solution;
 - Pour distilled water into each bulb and wait for 2 minutes;
 - Sterilized pieces of herbariums then laid out on filter paper with tweezers. The tweezers must be sterilized on an alcohol lamp every time;
 - Then we plant the herbarium pieces on breeding ground, we had PDA (Potato dextrose agar) and water agar. We put 5-6 pieces in each Petri dish.
 - We are waiting for 3-4 days of crop growth.
 - Then we prepare the samples and look under the microscope and determine the species by the method of I.I. Zhuravlev (1979) (by chasmotecia, appendages, ascospores and spores).

Results and discussion

According to the results of the research, the affected plants are new host-plants for this region.

The composition of species of phytopathogenic fungi of shrub plantations planted in the city of Karaganda is as follows:

1. *Microsphaera caraganae* L.

Order: Erysiphales

Family: Erysiphaceae

Genus: *Microsphaera* Lévl.

Species: *Microsphaera caraganae* L.

Host-plant: found on the leaves of *Caragana arborescens* Lam.

Located in Kazakhstan:

Karaganda c., the square on Nazarbayev Avenue. GPS-coordinates: N 49,81364; E 73,08816, altitude is 566 m above sea level;

Karaganda c., Ethnopark named after 10th anniversary of Independence of Kazakhstan. GPS-coordinates: N 49, 776648; E 73,125413, altitude is 566 m above sea level;

Date of finding: 26.09.–30.09.2020 y.

Morphology: chasmothecia are arranged in groups, spherical, large, 85-95 µm in size, the number of appendages is also large. Asci 4-5, size 34.5-50.5 µm. Spores 5-6, size 19.5-20.5 x 12.5-15.5 µm.

Biological features and pathogenesis of the fungi: Leaf lesions during the collection of herbariums in the *C. arborescens* in the form of a white spot on the leaves, which appeared first in the form of individual spots, then on the entire surface of the leaf. Some of the leaves curled and fell off. The appearance of chasmothecia was noted. On all the studied leaves, the marsupial stage of pathogens developed with the formation of chasmothecia (Fig. 1). Well-defined large chasmothecia formed in large numbers on the leaves [8].



Figure 1. A — leaves of *Caragana arborescens*, affected by pathogenic fungi *Microsphaera caraganae* L.; B — *Microsphaera caraganae* L. under the microscope—20x (asci, ascospores, appendages, chasmothecia)

2. *Uromyces cytisi* J. Schröt

Order: Pucciniales

Family: Pucciniaceae

Genus: *Uromyces*

Species: *Uromyces cytisi* J. Schröt

Host-plant: found on the leaves of *Caragana arborescens* Lam.

Located in Kazakhstan:

Karaganda c., Central park. GPS-coordinates: N 49, 80191, E 73,07779, altitude is 566 m above sea level;

Alley of Family. GPS-coordinates: N 49,808313, E 73,081252, altitude is 566 m above sea level;

Alley of Love. GPS-coordinates: 49,808872 n.l., 73,080893 e.l., altitude is 566 m

Date and time of location: 20.09.2020 y., 11:15

Morphology: teleitospores are unicellular, on legs. Teleitospores are represented by velvety dark pads on the leaves of the affected plant. Urediniospores are rusty-brown, on legs, the shell is covered with spikes.

Biological features and pathogenesis of the fungi: The leaves of the plant are damaged. In our research, uredo and teliospores were encountered (Fig. 2). The urediniospores are spherical, measuring 14.5-22.5 x 12-15. 25 μm . Teliospores are light brown, rounded, ovoid in size 17.75-25 x 12.5-15.5 μm . 05.08.1956, for the first time N.A. Gamalitska found on plants *C. arborescens* [9].



Figure 2. A — leaves of *Caragana arborescens*, affected by pathogenic fungi *Uromyces cytisi*; B — *Uromyces cytisi* J. Schröt (20x) under the microscope (ascospores)

Conclusions

According to the results of our research in the city of Karaganda, 1 species of powdery mildew fungi *Microsphaera caraganae* L. and 1 species of rust fungi *Uromyces cytisi* J. Schrötwere identified in the shrub *Caragana arborescens*Lam.

According to the results of the conducted studies, it was revealed that rust fungi cause *Caragana arborescens* Lam. the disease “rust”, which leads the plant to premature drying, lagging in growth and then to death. On our studied samples of leaves affected by rust, the stage of development of urediniospores was found, which are scattered along the underside of the leaf with sparsely spaced spiny warts. Teleitospores are represented by an ellipsoid or inversely ovoid shape, the shell is light brown.

Powdery mildew fungi cause *C. arborescens* the disease is “powdery mildew”, which affects the leaves and manifests itself as a white spot. In our studies, the marsupial stage of development of the fungi *Microsphaera caraganae* L. was found.

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Қарағанды қаласында өсетін ағаш қараған *Caragana arborescens* Lam. фитопатогенді саңырауқұлақтары

Мақалада Қарағанды қаласының көшелерінде, скверлерінде және саябақтарында өсетін бұталы өсімдіктердің ұнтақты және тат саңырауқұлақтарын анықтау нәтижелері берілген. Сонымен қатар иелік-өсімдігі ағаш қараған (*Caragana arborescens* Lam.) болатын фитопатогенді саңырауқұлақтардың түрлік құрамы туралы мәліметтер келтірілген. Фитопатогендік саңырауқұлақтарды жемісті денелері, өсінділері, қалталары мен споралары арқылы анықтау әдістері туралы тәжірибелік ақпарат берілген. Фитопатогендік саңырауқұлақтар олардың иелік-өсімдіктеріне, даму жағдайларына және өсіп-өну мерзіміне тікелей байланысты. Қаланы көгалдандыру үшін пайдаланылатын өсімдіктердің жағдайын уақтылы зерттеу, белгілі бір аймақтың климаттық жағдайларына сәйкес ауруларды, олардың даму деңгейін, таралуын, биологиясын анықтау осы зиянды организмдердің таралуын болдырмауға, олармен тиімді күрес шараларын жүргізуге негіз болып табылады. Бұл аймақ үшін алғаш рет ағаш қараған бұтасы (*Caragana arborescens* Lam.) келесі фитопатогендік саңырауқұлақтардың түрлеріне, атап айтсақ: *Microsphaera caraganae* L. ақұнтақ саңырауқұлағына, *Uromyces cytisi* J. Schröt тат саңырауқұлағына иелік-өсімдік болып саналады.

Кілт сөздер: өнеркәсіптік қала, бұталы көшеттер, ағаш қараған (*Caragana arborescens* Lam.), фитопатогендік саңырауқұлақтар, ақұнтақ саңырауқұлақтары, тат саңырауқұлақтары, *Microsphaera caraganae* L., *Uromyces cytisi* J. Schröt.

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Фитопатогенные грибы Караганы древовидной *Caragana arborescens* Lam., произрастающей в городе Караганде

В статье приведены результаты определения мучнисто-росяных и ржавчинных грибов кустарниковых растений, произрастающих на улицах, скверах и парках города Караганды, а также данные о видовом составе фитопатогенных грибов, где растением-хозяином является карагана древовидная (*Caragana arborescens* Lam.), произрастающая в указанной местности. Дана практическая информация о методах определения фитопатогенных грибов по плодовым телам, придаткам, сумкам и спорам. Фитопатогенные грибы напрямую зависят от растения-хозяина, условий развития и срока продолжения вегетации. Своевременное изучение состояния растений, используемых для озеленения города, выявление болезней, уровня их развития, распространения, биологии в соответствии с климатическими условиями данного региона являются основой для предотвращения распространения этих вредных организмов, проведения с ними эффективных мер борьбы. Впервые для этого региона кустарник *Caragana arborescens* Lam. является растением-хозяином для таких видов фитопатогенных грибов, как мучнисто-росяной гриб *Microsphaera caraganae* L., ржавчинный гриб *Uromyces cytisi* J. Schröt.

Ключевые слова: промышленный город, кустарниковые насаждения, карагана древовидная (*Caragana arborescens* Lam.), фитопатогенные грибы, мучнисто-росяные грибы, ржавчинные грибы, *Microsphaera caraganae* L., *Uromyces cytisi* J. Schröt.

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