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RESEARCH ARTICLE

First detection of *Colletotrichum gloesporioides* (penz.) Pens. & sacc. On *Liriodendron chinense* (hemsl.) Sarg. in Ukraine

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Abstract

Purpose of the research was to identify the pathogenic agent, to study its trophic specialization in the context of introduction of plants of the genus Liriodendron L. For the first time in Ukraine, affection of leaves and branches with anthracnose *Colletotrichum gloesporioides* (Penz.) Pens. & Sacc. was detected on *Liriodendron chinense*. Affected leaves turn yellow and fall prematurely. It was established that the highest development of the disease (7.3%) was observed in 2014, which was determined by favourable weather conditions (hydrothermal coefficient (HTC) 2.0 in April and 1.7 in May). Period 2013, 2015 was characterized by a significantly lower manifestation of anthracnose and became 2.2%, 2.6%, respectively. With a strong development of the disease, infection is observed in the branches as well-the bark darkens in the places of affection, the cambium dies off, the branch dries out. For the protection of plants against anthracnose, agro technical measures are recommended, as well as the use of fungicides. It should be noted that since the first signs of the disease it takes about 10-15 days until the death of the leaves. With the strong development of the disease, the infection of branches is observed as well. The use of Champion and Chorus preparations to protect the *Liriodendron chinense* against anthracnose showed that their effectiveness is high, and the development of the disease have decreased to 0.3% and is not harmful.

Keywords: *Colletotrichum gloesporioides* (Penz.), *Liriodendron chinense* (Hemsl.) Sarg, introduction of plants, phytopathogen

Introduction

Genus *Liriodendron* L. (tulip trees) is a member of the Magnoliaceae Juss. family and it includes two species- *Liriodendron tulipifera* L. and *Liriodendron chinense* (Hemsl.) Sarg. Two species *Liriodendron tulipifera* L. and *Liriodendron chinense* (Hemsl.) Sarg. are cultivated in the A. V. Fomin Botanical Garden.

This is a tall, deciduous, straight-stemmed tree. The simplest distinguishing feature of these plants is the unusual shape of the leaves. They are lyre-shaped, in most cases consisting of four laminas with inversely heart-shaped, dedalous apex. The flowers are calycine, almost completely colored orange, with the exception of the upper greenish endings (Cindy et al., 2013). The species is often affected by diseases, among which fungoid diseases have been especially dangerous in recent years. Anthracnose on the *Liriodendron chinense* is a new disease, the causative agent of which is the fungus *Colletotrichum gloesporioides* (Penz.) Pens. & Sacc.

Therefore, the purpose of the research was to identify the causative agent of the disease, to study its trophic specialization in the context of the introduction of plants of the genus *Liriodendron* L. in the A. V. Fomin Botanical Garden.

Materials and Method

Systematic analysis of mycobiota on the collections of the introduced plants of the A. V. Fomin Botanical Garden was

conducted in the period 2010-2017. Stationary observations were carried out by the method of complete surveys of implantations with an interval of once a decade during the growing season (from April to November). Plant parts with visible signs of disease were selected for a detailed analysis. The affected plants were analyzed, as well as herbarium material (its description was carried out, characteristic symptoms of the disease were pointed out), the time of symptoms onset, the dynamics of the development of diseases were noted.

Conventional mycological and phytopathological research methods were used to identify mycobiota on the leaves and branches of the tulip tree (Liriodendron) (Bilay 1982).

The test samples were placed in a humid chamber on two layers of filter paper moistened with sterile water. They were incubated at a temperature of 25°Cand observations were made on days 3, 5, 7, and 10 after laying the material under study. Using the method of direct inoculation, the samples were laid on nutrient media-on the surface of potato dextrose agar. They were cultivated at 25°C during 3-5 days (Bilay 1982). Records were carried out with an interval of 2-3 days. Isolated species of micromycetes were identified by the morphological and cultural characteristics of the fungus, using an XS-3220 light microscope (*600). Microphotography was performed using microscope digital imager "Celestron". More than 60 microscope slides of the studied fungus species were examined.

The taxonomic identity of micromycetes was established with the help of domestic determinants (Pidoplichko 1977, 1978; Pidoplichko & Milko, 1971).

Results

There are two types of liriodendron in the Botanical Garden: Chinese (*Liriodendron chinense* (Hemsl.) Sarg. and tulip tree (*L. tulipifera* L.). According to A. N. Kolisnichenko, the beginning of the growing season of these plants is marked on 17.IV ± 10 and continues 172 ± 9 days. Plants bloom irregularly (16.VI ± 12 to 29.VI ± 14 days). They rarely fructify, the seeds are empty, as a rule.

In 2010, for the first time in Ukraine, the affection of leaves and branches with anthracnose *Colletotrichum gloesporioides* (Penz.) Pens. & Sacc. was detected on *Liriodendron chinense*.

Our regular phytopathological examinations during eight years have shown that the fungus *Colletotrichum Gloesporioides* (Penz.) Pens. & Sacc parasitizes only on *Liriodendron chinense* (Hemsl.) Sarg. No fungus was detected on *Liriodendron tulipifera* L. Artificial infection of the leaves with the pathogen of this plant was unsuccessful. It can be said with great certainty that *L. tulipifera* L. is resistant to this fungus.

As a result of annual surveys throughout 2010-2017, the average indicators of the development of anthracnose on a tulip tree in the context of the A. V. Fomin Botanical Garden was established (Tab. 1).

It was established that the highest development of the disease (7.3%) was observed in 2014, which was determined by favourable weather conditions (HTC 2.0 in April and 1.7 in May). Period 2013, 2015 was characterized by a significantly lower manifestation of anthracnose and became 2.2%, 2.6%, respectively.

Observations showed that the first signs of disease on the leaves of *Liriodendron chinense* the Chinese appear at the beginning of blossoming and sometimes later. Yellow spots of various sizes with black dots concentrically arranged on them, which is fungal sporulation, are formed on the leaves (Fig. 1).

Table 1. Perennial dynamics of the development of anthracnose on *Liriodendron chinense*.

v	Months, HTC			Development of anthracnose
	IV	V	VI	
2011	0.7	0.4	1.2	3.9
2012	1.3	0.5	1	5.8
2013	0.5	0.8	0.6	2.2
2014	2	1.7	0.7	7.3
2015	0.5	1.1	0.6	2.6
2016	1	1.5	0.3	3.5
2017	2.1	0.7	0.4	5.8

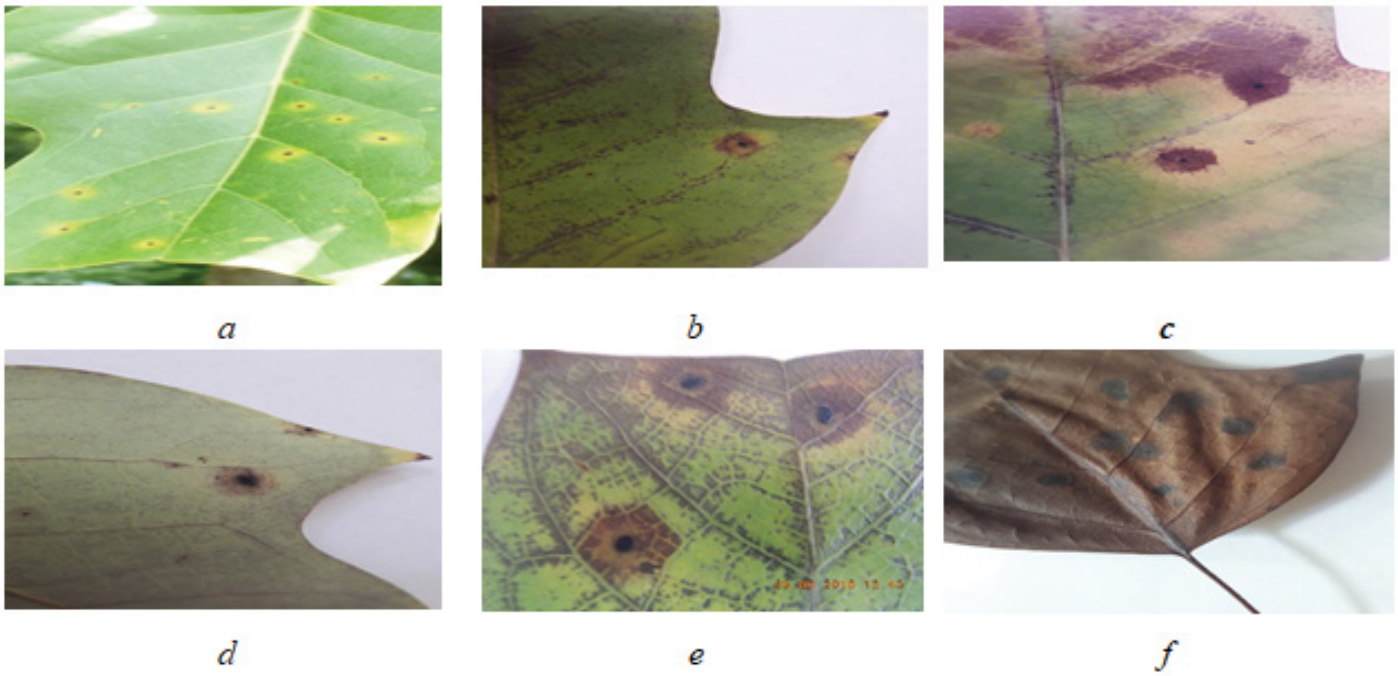


Figure 1. Symptoms of the dynamics of the leaves affection of *Liriodendron chinense* (Hemsl.) Sarg. with anthracnose *Colletotrichum gloesporioides* (Penz.) Pens. & Sacc.). a-30.V, b-15.VI, c-15.VII, d-15.VIII, e-2.IX, f-10.X (authentic photos).

The presence of setae on the conidial thalus was also noted, which is a sign of the fungi of the genus *Colletotrichum* Penz.

Based on the presented symptoms (yellow spots with concentric sporulation of the fungus, the presence of setae on the conidial thalus) and analysis of the size of conidia (Fig. 2) taken from the thalus of the fungus on the leaves of the *Liriodendron chinense* (Tab. 2), we identified this pathogen as *Colletotrichum gloesporioides* ((Penz.) Pens. & Sacc).

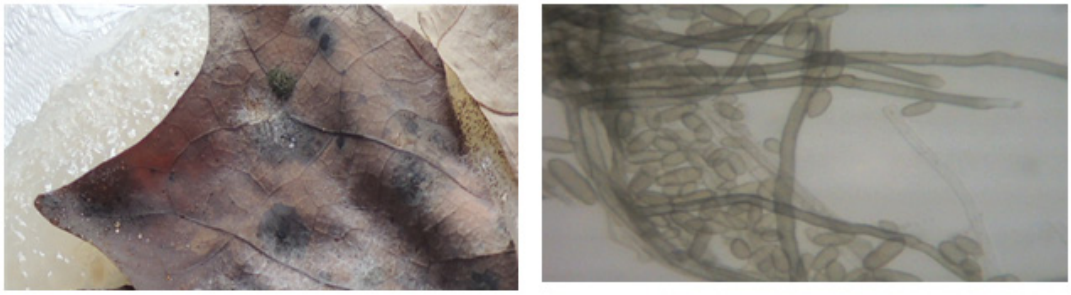
It was established that under favorable conditions the infection grows rapidly and continues until the end of September. Epiphytotics of anthracnose occurs in moderately warm and wet summer. The affected leaves turn yellow and fall prematurely. Since the first signs of the disease, it takes about 10-15 days until the death of the leaves. As a result of leaf abscission, the supply of nutrients is sharply reduced, and the violation of physiological functions leads to a decrease in growth, frost resistance, to the dying-off of individual branches, to a decline in the number of flowers in the next growing season.

The development of the disease always begins on the lower branches, on the older leaves. Mass development of the disease occurs at the end of July-in early August. With a strong affection, the bulk of the leaves may fall off by the end of August, which inevitably leads to the drying of the branches, which go into the winter without an adequate supply of macronutrients. As a result, buds and entire branches are frost-killed in winter. With the strong development of the disease, infection is observed in the branches as well- the bark darkens in the places of affection, the cambium dies off, the branch dries (Fig. 3).

For the protection of plants against anthracnose, agrotechnical measures are recommended, as well as the use of fungicides (Kotova and Kungurtseva, 2014). In the autumn, pruning of dead and infected parts of the branches is carried out, the affected leaves are collected and burnt, the affected fallen leaves are embedded in the soil, or the fallen leaves are piled up with the soil (in order to apply soil antagonists). During the growing season of plants, it is recommended to use an increased dose of phosphorus, ash and microelement boron, which increases the resistance of plants.

With strong development of the disease, spraying with 1.0% Bordeaux mixture is carried out:

1. immediately after flowering



a *b*

Figure 2. Conidial rabies fungus and conidia of *Colletotrichum gloesporioides* ((Penz.) Pens. & Sacc.). a-conidial rabies fungus, b- conidia (authentic photo).

Table 2. Size of conidia of *Colletotrichum gloesporioides* Penz. on various host plants.

Source, year	Host plant	Size, micrometer
Zhuravliov et al., 1979	Privet	10.0-13.0 × 3.5-4.0
Shevchenko, Tsyriulik, 1986	Privet	11.5-19.5 × 3.5-5.0
Pieriesypkin, 1989	Citrus plants	10.0-19.5 × 3.0-4.5
Okryun Choi et al., 2012	*Liriodendron chinense*	10.0-18.0 × 3.0-5.0
Botanical Garden, 2012	*Liriodendron chinense*	10.0-18.5 × 3.0-4.5

Figure 3. Drying of branches of *Liriodendron chinense* (Hemsl.) Sarg., affected with anthracnose (*Colletotrichum gloesporioides* (Penz.) Pens. & Sacc.) (authentic photo).

Table 3. The effectiveness of using fungicides against anthracnose on *Liriodendron chinense* (2015-2017).

Option	The concentration of preparation, %	Indicators of disease development, %					
		before spraying		after spraying			
		6.06		13.06		27.06	
		A	D	A	D	A	D
Control (water treatment)	–	11.3	7.4	27.6	2.8	32.1	3.9
Champion	0.2	12.1	6.6	5.4	2	1.2	0.3
Chorus	0.1	11.9	7.1	6	2.4	2.1	0.4

Note A- affection of leaves with anthracnose, %; D-degree of disease development, %

2. 10-15 days later

3. another 10-15 days later (Agronomist's Reference Book, 1948)

The Champion and Chorus preparations used for the protection of the *Liriodendron chinense* against anthracnose showed that their effectiveness is high (Tab. 3). Burns of leaves from the use of these preparations was not observed.

Discussion

Glucososporic anthracnose (*Colletotrichum gloesporioides* (Penz.) Pens. & Sacc.) from the order Melanconiales is distributed mainly in the subtropical zone. The fungus infects citrus plants (*Citrus* L.) (Agronomist's Reference Book, 1948; Farr & Rossman, 2010), privet (*Ligustrum* L.) (Shevchenko & Tsyliurik, 1986), rhododendrons (*Rhododendron* L.) (Egorova, et al., 2008) as well as plane tree (*Platanus* L.), oak (*Quercus* L.), elm (*Ulmus* L.), cornel (*Cornus* L.), (maple (*Acer* L.), liriodendron (*Liriodendron* L.) (Okryun et al., 2012) and many other plants.

As noted (Shevchenko & Tsyliurik, 1986; Farr & Rossman, 2010), the mycelium of phytopathogen is located in the intercellular spaces; it forms conidial sporulation in the form of a thalus under the epidermis of plant tissues. Later, the epidermis is broken and the sporulation extends to the surface of the affected organs. Around the thalus, where conidiophores and conidia develop, there are brown setae, giving it a dark coloration. Conidia are unicellular, colorless, and on the whole pinkish. Under humid conditions with the abundant formation of conidia, the thalus becomes pinkish in color. The pathogen is spread by conidia, and the mycelium overwinters in the affected parts of plants. Leaves, shoots, and fruits are affected (on citrus plants and privet). First light-brown and later greyish rounded spots appear on the leaves, they are clearly expressed on both sides of the leaf blade. The tops of the shoots take the first brown and then light-grey color and dry. In wet weather, the fungus sporulation appears on them.

Opinions of different researchers about the harmfulness of glucososporic anthracnose differ. Some say that the harmfulness of anthracnose on citrus plants manifests itself in a decrease in the yield of fruits and deterioration in their quality, as well as in a reduction in the period of fruiting and plant life. The fungus causes the death of young seedlings of privet. It takes approximately 10-15 days since the appearance of the first signs of the disease until the death of the seedlings of this plant (Shevchenko & Tsyliurik, 1986). On rhododendrons, *Colletotrichum gloeosporioides*, it causes leaf spots and shrinkage of buds (Egorova, 2008). Other researchers did not observe defoliation of leaves affected by the fungus and the death of *Liriodendron chinense* (Okryun et al., 2012).

Conclusion

For the first time in Ukraine, the affection of leaves and branches with anthracnose *Colletotrichum gloesporioides* (Penz.) Pens. & Sacc. was detected on *Liriodendron chinense*.

The affected leaves turn yellow and fall prematurely. Since the first signs of the disease, it takes about 10-15 days until the death of the leaves. With the strong development of the disease, infection is observed in the branches as well- the bark darkens in the places of affection, the cambium dies off, the branch dries. No fungus was detected on *Liriodendron tulipifera* L. and artificial infection was unsuccessful.

The use of Champion and Chorus preparations to protect the *Liriodendron chinense* against anthracnose showed that their effectiveness is high, and the development of the disease has decreased to 0.3% and is not harmful.

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