Determination of the pathogenicity of the fungi *Leveillula Saxifragacearum* and *Sphaerotheca Mors Uvae* causing mildew disease

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Abstract. Powdery mildew-causing fungi constitute around ten percent of the documented fungal species found in Uzbekistan. Among these fungi, a significant portion has developed adaptations to thrive in arid climatic conditions, reflecting their ability to endure dry environments. However, it's noteworthy that there also exists a substantial presence of fungi within this group that prefer moisture-rich surroundings. This variation in ecological preferences is evident not only between different fungal species but also within species belonging to the same botanical family. Such diversity in moisture requirements underscores the complex interplay between these fungi and the unique environmental conditions present in Uzbekistan. The article outlines a methodology and presents experimental data aimed at assessing the pathogenicity of two fungi, namely Leveillula saxifragacearum and Sphaerotheca mors uvae. These fungi are responsible for causing powdery mildew, a fungal disease, in the blackcurrant plant. The significance of this plant lies in its medicinal properties. The study provides insights into the mechanisms through which these fungi affect the blackcurrant plant and cause powdery mildew, which can have detrimental effects on its growth and health. By detailing the experimental approach and sharing gathered data, the article contributes to a better understanding of the interactions between these fungi and the medicinal blackcurrant plant. This research has the potential to guide efforts to manage and mitigate the impact of powdery mildew on blackcurrant cultivation, ultimately preserving and enhancing the plant's medicinal qualities.

Keywords. Pathogenicity, fungus, scab, seedling, disease, powdery mildew, spore, spread, development, *Sphaerotheca mors uvae*, *Leveillula saxifragacearum*, damage.

1 Introduction

Fungi that cause powdery mildew in plants make up one tenth of the recorded fungal species in Uzbekistan. Most of these fungi are adapted to dry climatic conditions, but there are also many moisture-loving species. Such a difference can be observed even among species belonging to the same family [1, 2].

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The homeland of blackcurrant powdery mildew or spherotheca disease is North America, from where the disease entered Europe and later spread to other countries. This causative agent was considered to be an obligate parasite adapted only to kryzhovnik. But later, it was noted that this type of fungus, which causes powdery mildew, also severely damages blackcurrants. When black currant is infected with powdery mildew, its leaves are covered on both sides with white powdery mildew consisting of mycelium and conidia of the fungus. Later, the branches of the plant are completely covered with such dust [3-6].

Red currant shoots need a shorter period of time to develop than black currants. Because of this, it was observed that blackcurrant is severely damaged by powdery mildew [7, 8]. Golden black currant, which is grown as a landscape shrub, is strongly affected by powdery mildew [9, 10].

More damage from powdery mildew disease is observed when it damages the growth point of the bushes. In this case, the joint between the stem and the branches becomes short. The leaves formed in them are small, colorless, and often have a deformed appearance [11]. Diseased fruits develop slowly, if the disease is severe, they shrivel and fall off [12].

Spores of the fungus are produced in the spring and infect the growing point of blackberry shoots and young leaves. It takes 1-1.5 months for the spores to fly out of the bags, and for their germination, moisture is sufficient and the air temperature should not be lower than 15-17 °C [13, 14].

It was noted that blackberry leaves, branches, inflorescences were affected by powdery mildew caused by *Leveillula saxifragacearum* . The infected parts of blackcurrant were covered with first sparse, then dense white powders consisting of mycelia, conidiabands and conidia of the fungus. Diseased branches were behind in growth and development [15-17].

Blackberry leaves, branches and fruits are affected by powdery mildew caused by *Sphaerotheca mors - uvae* . The disease first affected the leaf bands, then the lower part of the leaf and the main veins. On the back side of such leaves, a gray mesh-like powder formed, consisting of mycelia of the disease-causing fungus [18-20]. Due to the disease, the leaves did not develop well and became colorless. On the surface of the fruits of the affected plant, dense, gray dust formed by the disease-causing fungus was visible. Fruits affected by the disease fell without development.

2 Materials and methods

To study the pathogenic properties of fungi that cause powdery mildew, it is most convenient to use cleistothecium mevatanas, which occur during the formation of their bags. The ascospores produced by these mevatanas have the potential to infect more plant species than fungal conidia. But it is not always possible to use these fruits. Because the fungal species, depending on the conditions of the area where they are studied, may produce cleistothecium fruiting bodies in very small quantities in the affected plant parts, or some species may not produce them at all. Some fungi need to be overwintered to restore fruiting bodies. Ascospores inside them lose their sterility due to rapid decay of the skin of some fruits in aqueous environment. Therefore, when determining the pathogenicity of fungi that cause powdery mildew, spores during the formation of conidia are often used. Because it is possible to multiply conidia of fungi in large quantities in natural substrates in a short period of time. To carry out the experiments, the leaves and branches of the plant infected with powdery mildew disease were collected under natural conditions and placed in wet chambers in Petri dishes.

To form a humidity chamber, Petri dishes were sterilized with filter paper and sterilized in an autoclave at 121°C for 20 minutes at a pressure of 0.5 atm. After removing the Petri dishes from the autoclave, they were moistened by pouring 1 ml of sterilized water into

each of them in a laminar box. Petri dishes prepared in this way were used to conduct the above experiments.

The Petri dishes containing the parts of the plant affected by powdery mildew were kept for 1 day in a thermostat with a temperature of 24-26°C. Then, the fungal conidia that appeared on the surface of the affected plant parts inside the Petri dishes were collected by tapping them from the plant parts into new sterile Petri dishes. After the collection of conidia of powdery mildew fungi, their viability was determined in laboratory conditions. To test the viability of conidia in the laboratory, preparations were prepared from them and these preparations were observed under a microscope. If the vacuoles of conidial cells are clearly visible, such conidia have not lost their growth properties. If the cells of the conidia are filled with a granular mass, such conidia are considered to have lost their ability to germinate. For artificial infection of plants, options were selected on the basis of this criterion, that is, conidia germination of not less than 70%.

According to literary sources, the incubation period of fungi that causes powdery mildew in plants can last from 2 to 28 days, depending on the temperature. It was determined that high humidity reduces the germination of conidia and reduces the ability to infect plants [10, 13, 19]. These aspects were taken into account when artificially infecting plants with these fungi.

3 Results and discussion

In the conditions of Tashkent region, two types of powdery mildew disease were noted in currants. The causative agent of the first appearance *is Leveillula saxifragacearum* Golov. f. ribis Golov. is a type of fungus , and the appearance of the second type was recorded only once during all studies, and its causative agent is *Sphaerotheca mors uvae* (Schw.) Berk. et Curt. it was determined to be a type of fungus, and it became known that the disease in this form is called "American mildew" in scientific literature (Table 1).

Table 1. Types of fungi causing powdery mildew in currants.

The type of fungus that causes the disease	Name of the causative disease	Occurrence
Leveillula saxifragacearum Golov. f. ribis Golov.	Flour is dew	+++
Sphaerotheca mors uvae (Schw.) Berk. et Curt.		+

Experiments on the study of fungi that cause powdery mildew were carried out on seedlings grown from cuttings in flower beds. The average temperature of the laboratory during the period of conducting experiments on blackcurrant plant was 12-14°C at night and 28-30°C during the day. Experiments were conducted in three variants. In variant I, *Leveillula saxifragacearum* Golov. f. ribis Golov. of the fungus, in variant II *Sphaerotheca mors uvae* (Schw.) Berk. et Curt. Conidia of the American powdery mildew fungus were used. In option III, blackberry seedlings that were not affected by the disease were used as a control.

Currant infection with powdery mildew was carried out using the above methods. Experiments were carried out in three replicates, and four pots with two seedlings planted in each replicate were used. Disease development in blackberry seedlings artificially infested with powdery mildew fungi was observed and counted from the third day.

The first symptoms of the disease appeared in blackcurrant seedlings 6 days after infection. On the 9th day, all the seedlings in the experimental options were 100% infected with the disease (Figure 1).

Figure 1. Blackcurrant seedlings artificially infested with powdery mildew fungus.

The development of powdery mildew was observed to be 1.8-2.0% in option I and 1.4% in option II on the 6th day, and this indicator reached 2.3-2.8% and 1, It was observed that it was 9-2.2%.

Leveillula saxifragacearum f., which causes the widespread powdery mildew disease in all farms of Tashkent region of Uzbekistan. It was found that the disease spread early and the development was accelerated in the seedlings of variant I of the experiments using ribis fungus.

Sphaerotheca mors uvae, which was recorded once in blackcurrant in the high mountain area of Parkent district of Tashkent region, the development of the disease in seedlings was relatively slow, but later its development accelerated.

Symptoms of powdery mildew diseases caused by fungi used in options I- and II- were the same as the diagnosis of the disease encountered in farms (Tables 2 and 3).

Table 2. Pathogenicity of powdery mildew fungi on currant seedlings.

#	Experiments	Number of pots in experimental iterations	Number of seedlings in one pot	Disease prevalence, %					
				Days of receipt of the bill of illness					
				3	6	9	12	15	18
1	**Option I** *Leveillula saxifragacearum* f. ribis fungus was used	4	2	-	50.0	100	100	100	100
2		4	2	-	50.0	100	100	100	100
3		4	2	-	-	50.0	100	100	100

4	**Option II** The fungus *Sphaerotheca mors uvae* was used	4	2	-	50.0	100	100	100	100
5		4	2	-	-	50.0	100	100	100
6		4	2	-	-	50.0	100	100	100
7	**Option III** Control (undamaged)	4	2	-	-	-	-	-	-
8		4	2	-	-	-	-	-	-
9		4	2	-	-	-	-	-	-

Table 3. Pathogenicity of powdery mildew fungi on currant seedlings.

#	Experiments	Number of pots in experimental iterations	Number of seedlings in one pot	Disease development, % the days of receipt of the bill of illness									
				3	6	9	12	15	18	21	24	27	30
1	**Option I** *Leveillula saxifragacearum* f. ribis fungus was used	4	2	-	1.8	2.5	3.1	5.4	7.6	10.5	15.3	22.6	30.8
2		4	2	-	2.0	2.8	3.2	5.6	7.8	10.9	15.7	22.8	29.5
3		4	2	-	-	2.3	2.9	4.8	7.1	8.0	12.3	18.4	25.0
4	**Option II** The fungus *Sphaerotheca mors uvae* was used	4	2	-	1.4	2.2	3.0	4.7	6.6	7.0	11.8	19.7	30.4
5		4	2	-	-	2.0	2.8	4.5	6.3	7.9	10.8	17.0	27.5
6		4	2	-	-	1.9	2.6	4.4	6.2	7.4	10.6	16.4	28.0
7	**Option III** Control (undamaged)	4	2	-	-	-	-	-	-	-	-	-	-
8		4	2	-	-	-	-	-	-	-	-	-	-
9		4	2	-	-	-	-	-	-	-	-	-	-

Although the development of the disease in blackberry seedlings artificially infested with the fungus Sphaerotheca mors uvae II was a little slower in the initial period, the disease developed rapidly, and after 45 days after infection, the leaves of all the seedlings in this variant dried and hung on the plant without shedding . All the sick seedlings turned brown.

The withering condition of the seedlings of variant I was observed on the 52nd day after infection. The leaves of the dead seedlings became brittle when plucked by hand. All such seedlings turned gray.

During the determination of the pathogenicity of blackcurrant seedlings by artificially infecting them with powdery mildew fungi, it was found that the plant will die completely within 50 days if the necessary conditions for the development of the disease exist. For the development of the fungus *Sphaerotheca mors uvae*, the environment with slightly low temperature and high humidity is considered favorable.

4 Conclusions

Blackcurrant seedlings were intentionally exposed to Leveillula saxifragacearum and Sphaerotheca mors uvae fungi. Within a span of 12 days, the disease had completely proliferated in both scenarios, encompassing a spread rate of 100%. Subsequently, in the first experimental condition (option I), over a period of 52 days, the disease displayed a developmental extent ranging from 63.5% to 64.2%.

Conversely, in the second experimental condition (option II), the disease exhibited a slightly lower development range of 61.4% to 63.9%, and this occurred over a shorter timeframe of 45 days. These findings highlight the rapid and consistent progression of the disease caused by the mentioned fungi in blackcurrant seedlings, shedding light on the differing rates of disease development between the two experimental setups.

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