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Types of Fungi Species Attacking Mulberry, Symptoms, and Their Interaction

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Abstract

Mulberry trees (Morus spp.) are essential in sericulture since their leaves are the primary source of nutrition for silkworms (Bombyx mori L.). The cultivation of mulberry trees has long been integral to the silk industry, particularly in countries like China, India, and Japan. However, like all agricultural crops, mulberry trees are vulnerable to a variety of pests and pathogens including fungi. Fungal diseases can have a profound impact on mulberry trees thus leading to reduced leaf quality, stunted growth, and even death of the tree in severe cases. Fungal infections not only affect the health of the mulberry trees but also have direct consequences on the silkworm industry. Healthy mulberry trees are necessary to sustain the silkworm population and produce high-quality silk. As such, understanding the types of fungi species that attack mulberry, the symptoms of fungal infections and how these pathogens interact with mulberry trees is essential for effective management and prevention strategies. This article will discuss various fungal species that attack mulberry trees, outline the symptoms they cause, and explore their interactions with mulberries. We will also cover the importance of fungal control in sericulture and provide insights into integrated management strategies.

Keywords: Disease management, disease symptoms, fungal-plant interaction, fungal pathogens, mulberry diseases, root rot fungi

INTRODUCTION

Fungi play a significant role in the health and productivity of mulberry (*Morus spp.*), a critical crop for the sericulture industry [1]. Numerous fungal species are known to attack mulberry plants thereby causing diseases that adversely affect leaf yield and quality [2]. These fungi belong to various genera including *Phyllactinia*, *Cercospora*, *Fusarium*, and *Alternaria*. Each species exhibits distinct pathogenic mechanisms, symptomology, and interactions with the host plant, necessitating targeted management strategies [3]. Key fungal diseases include powdery mildew (*Phyllactinia corylea*), characterized by white powdery patches on leaf surfaces; leaf spot (*Cercospora moricola*), causing circular brown spots leading to defoliation; root rot (*Fusarium solani*), marked by wilting and decay of roots and leaf blight (*Alternaria alternata*), identified by irregular necrotic patches [4]. These diseases significantly impair mulberry growth and reduce its nutritional value thereby directly affecting the silkworm-rearing process [5]. The interaction between mulberry and fungal pathogens is complex, involving intricate biochemical and physiological responses [6]. Fungal infections often trigger defence mechanisms in mulberry, such as the production of phytoalexins and activation of antioxidant pathways. However, aggressive pathogens can overcome these defences thus leading to severe infestations. Environmental factors, such as humidity, temperature, and soil

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conditions also influence the severity and spread of fungal diseases [7]. This article reviews the diversity of fungi affecting mulberry, the associated symptoms, and the plant-pathogen interactions. Understanding these dynamics is essential for formulating effective management strategies that promote the sustainability and productivity of sericulture.

TYPES OF FUNGI SPECIES ATTACKING MULBERRY TREES

Several fungal species are known to infect mulberry trees, each causing different diseases with varying degrees of severity [8]. These diseases thrive in specific environmental circumstances, such as high humidity, poor soil drainage, and minimal tree maintenance. The major fungal species affecting mulberry include:

Fusarium Species (*Fusarium* spp.)

Fusarium is one of the most damaging fungal infections affecting mulberry trees [9]. The *Fusarium* species are soil-borne fungi that cause root rot which can severely damage the mulberry trees [10]. *Fusarium wilt*, caused by *Fusarium oxysporum* was particularly harmful to mulberry trees. This infection enters the plant's vascular system, interfering with the delivery of water and nutrients.

Symptoms

1. The yellowing of the leaves (chlorosis) starting from the bottom of the tree.
2. Wilting and drooping of the leaves, even when the soil is moist.
3. Dying behind branches and twigs thereby leading to dieback in severe cases.
4. Dark streaks or lesions around the vascular tissue area, are visible when open.

Interaction with Mulberry

Fusarium species primarily infect mulberry trees through the roots. Once the fungus enters the vascular system, it blocks the flow of water and nutrients thus leading to dehydration and nutrient deficiencies [11]. The pathogen also produces toxins that damage plant tissues, further exacerbating the disease. *Fusarium wilt* can spread rapidly, especially in poorly drained soils thus making it one of the most challenging fungal diseases to control [12].

Phytophthora Species (*Phytophthora spp*.)

Phytophthora is a genus of water molds that cause root rot and stem rot diseases in mulberry trees. *Phytophthora cinnamomi* and *Phytophthora parasitica* are the primary species responsible for these infections in mulberries. These pathogens are particularly problematic in areas with high rainfall or poor drainage, as they thrive in waterlogged conditions [13].

Symptoms

1. Root rot often causes the roots to become dark, soft, and decayed.
2. Yellowing of leaves, especially in the lower parts of the tree.
3. Wilting and stunted growth due to the lack of proper nutrient uptake.
4. Sudden death of branches is visible.

Interaction with Mulberry

Phytophthora fungi attack mulberry trees by infecting the roots or lower stem. The pathogens spread through soil, especially in areas with standing water. As the roots rot, they can no longer absorb water or nutrients which leads to the wilting and death of the tree. *Phytophthora sp* also produces spores that can spread rapidly in moist environments thus making it difficult to control once an infection takes hold [14].

Colletotrichum Species (*Colletotrichum* spp.)

Colletotrichum species cause anthracnose disease in mulberry trees. This disease is particularly prevalent in humid and warm climates, where the fungal spores thrive on the leaf surfaces, stems, and

fruits. *Colletotrichum gloeosporioides* is the most common species associated with anthracnose in mulberry [15].

Symptoms
1. Dark and sunken lesions on the leaves thus often surrounded by yellow halos.
2. Infected leaves may curl, dry up, and eventually fall off the tree.
3. Branch lesions lead to dieback.
4. Fruits and young shoots can also show signs of infection.

Interaction with Mulberry

Colletotrichum sp. fungi infect mulberry trees through direct contact with the spores. The fungus penetrates the plant tissues thereby causing necrotic lesions. The disease primarily affects leaves and twigs which are essential for photosynthesis [16]. As the illness progresses, it can weaken the tree, making it more susceptible to other infections.

While the disease rarely kills the tree outright, it can lead to significant loss of leaf area thus reducing the food supply for silkworms.

Alternaria Species (*Alternaria spp*.)

The genus *Alternaria* includes several fungal species that affect mulberry trees thus causing Alternaria leaf spot. This disease is more prevalent in areas with high humidity, and it primarily affects the leaves and stems [17].

Symptoms
1. Small, dark, circular spots on the upper side of the leaves thus often with concentric rings.
2. Affected leaves may eventually turn yellow and fall prematurely.
3. In severe cases, the spots can spread to the branches and cause dieback.

Interaction with Mulberry

Alternaria species infect mulberry leaves through direct contact with spores. The fungus thrives in humid conditions and produces a mycelium that invades the leaf tissues thereby leading to the characteristic spots. The infection weakens the leaves thus reducing their photosynthetic ability and consequently, the tree's overall health. While it is unlikely to cause the death of the tree, *Alternaria* sp. can significantly affect the quality of mulberry leaves thus reducing their value for sericulture [18].

Cercospora Species (*Cercospora spp.*)

Cercospora sp fungi are responsible for causing *Cercospora* leaf spot in mulberry trees. The illness is distinguished by the appearance of black, round spots on the leaves and is more common in tropical and subtropical areas where conditions encourage fungal multiplication [19].

Symptoms
1. Circular, grayish lesions with dark edges on the leaves.
2. Affected leaves may develop a yellowing border and eventually fall off.
3. Severe infections can cause premature leaf to drop thus leading to defoliation.

Interaction with Mulberry

Cercospora sp. fungi infects the leaves of mulberry trees thereby causing necrotic lesions. The disease can impair the leaves' photosynthetic capacity thus resulting in a weakened tree and inhibited growth. In addition to the direct impact on the tree's health, the loss of leaves can reduce the supply of food for silkworms which depend on healthy, abundant mulberry foliage for nourishment [20].

Botryosphaeria Species (*Botryosphaeria spp.*)

Botryosphaeria sp. fungi are known to cause Botryosphaeria dieback in mulberry trees (Kalbande and Yadav, 2021). This disease primarily affects the branches and stems of the tree and is particularly

severe in older trees or those stressed by environmental factors [21].

Symptoms

1. Sudden wilting of branches and twigs.
2. Dark and sunken lesions on the bark.
3. Cracking and splitting the bark.
4. Leaf yellowing and premature shedding.

Interaction with Mulberry

Botryosphaeria sp. fungi typically enter mulberry trees through wounds in the bark or branches. The fungus spreads through the vascular system thus causing necrosis and dieback in the infected parts of the tree [12]. This leads to reduced vitality and in severe cases, tree death. While it does not directly affect the leaves initially, the loss of branches can result in a substantial reduction in the tree's overall leaf production thereby impacting sericulture [9].

Symptoms of Fungal Infections in Mulberry Trees

The symptoms of fungal infections in mulberry trees vary depending on the specific pathogen involved. However, some common signs of fungal diseases include:

- *Chlorosis:* Yellowing of the leaves, which is often an indication of nutrient deficiency due to root damage or impaired water uptake.
- *Wilting:* Drooping or wilting of the leaves, especially during warm weather which can result from vascular blockage caused by fungal infections.
- *Necrotic Lesions:* Dark, sunken spots on the leaves, branches or stems, indicative of tissue death caused by fungal invasion.
- *Defoliation:* Premature leaf drop thus often caused by leaf infections or general tree stress due to fungal attack.
- *Dieback:* The progressive dieback of branches or twigs, typically beginning at the tips and advancing inward.

Interaction of Fungi with Mulberry Trees

Fungal pathogens interact with mulberry trees in various ways depending on the mode of infection and the type of fungus involved. Fungi typically enter the tree through the roots, bark or leaves. Once inside, they spread through the vascular tissues, where they can block water and nutrient flow or produce toxins that damage plant cells [17]. Fungal infections are occasionally secondary, occurring after a tree has already been weakened by factors, such as drought, poor soil conditions, or insect infestation. The interaction between fungi and mulberry trees often results in a weakened immune system thereby making the tree more susceptible to further infections [21].

Management of Fungal Diseases in Mulberry

Fungal disease management in mulberry trees requires an integrated approach that combines cultural, chemical, and biological techniques. Key tactics include:

1. Providing adequate irrigation and drainage to prevent waterlogging, which promotes fungus growth.
2. Implementing pruning and cleaning procedures to remove infected branches and reduce pathogen spread.
3. To manage active fungal infections, fungicides should be used with caution to avoid the development of resistance.
4. Using biological control agents, such as benign fungus or bacteria, to inhibit or compete with hazardous infections.

CONCLUSIONS

Fungal infections in mulberry trees pose significant challenges to both tree health and the sericulture

industry. *Fusarium, Phytophthora, Colletotrichum, Alternaria, Cercospora and Botryosphaeria* are the primary fungal pathogens affecting mulberry, each causing distinct symptoms and interacting with the tree in various ways. Early detection and good management are critical for decreasing the impact of these diseases on mulberry yield. By understanding the types of fungi that attack mulberry trees, the symptoms they cause and their interactions with the tree, sericulturists can implement effective control measures to ensure healthy mulberry trees and a sustainable silk industry.

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