



Host Mulberry and Diseases Management

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In mulberry cultivation, effective management of diseases and pests is crucial for maximizing yield and quality. Constant vigilance and appropriate control measures are necessary to protect plants from various pathogens and pests, ensuring optimal productivity.

1. Diseases of Mulberry

Mulberry diseases are categorized based on plant parts affected, transmission mode, prevalence and parasitic nature. Plant parts affected include foliar, root, vascular and systemic diseases. Transmission modes are classified as seed-borne, airborne and soil-borne. Diseases are further divided into non-parasitic/non-infectious and parasitic categories. Non-parasitic diseases stem from nutrient deficiency or injuries, while parasitic diseases result from pathogen involvement (fungi, bacteria, viruses and nematodes).

1.1. FOLIAR DISEASES

1.1.1 Leaf Spot: The causal organism, *Cercospora moricola*, is prevalent during the rainy season followed by winter. Disease onset typically occurs 35-40 days after pruning/leaf harvesting, peaking around the 70th day. Crop loss reaches approximately 10-12%. Spread is airborne through conidia carried by rain droplets. Optimal conditions for disease development are temperatures of 24-26 °C and relative humidity of 70-80%.

Symptoms:

- Brownish necrotic, irregular spots appear on the leaf surface.
- Spots enlarge, extend and join together leaving characteristic shot hole.
- Leaves become yellow and wither off as disease becomes severe.

Control measures:

- Spraying of 0.2 % Bavistin (Carbendazim 50% WP) solution on the leaves.
- Safety Period: 5 days.

1.1.2. Powdery Mildew: The causal organism, *Phyllactinia corylea*, primarily emerges during winter and rainy seasons, peaking between the 40th and 70th day after planting (DAP) or leaf harvest. Crop loss ranges between 5-10%. Airborne transmission via conidia, propelled by wind currents, facilitates infection. Disease progression thrives in temperatures of 24-28°C and high relative humidity levels of 75-80%.

Symptoms:

- White powdery patches develop on the lower leaf surface, while corresponding areas on the upper surface show chlorotic lesions.
- Severe cases result in brownish-black patches and yellow, coarse leaves with reduced nutritive value.

Control measures:

- Follow wider spacing of plantation (90 cm x 90 cm) or paired row planting system [(90+150) × 60 cm]
- Spraying of 0.2 % Karathane (Dinocap 30% EC) / Bavistin on the lower surface of the leaves, safe period 5 days or spray Sulfex (80WP) 0.2%, safe period 15 days.

1.1.3. Leaf Rust: The causal organism, *Cerotelium fici*, is prevalent during winter and rainy seasons. Disease onset occurs approximately 45-50 days after planting (DAP), peaking by the 70th DAP, notably affecting mature leaves. Crop loss ranges from 10-15%. Airborne dispersal of uredospores via water droplets and wind currents facilitates spread. Favourable conditions for development include temperatures of 22-26°C and relative humidity levels exceeding 70%.

Symptoms:

- Initially, circular pinhead sized brown eruptive lesions appear on the leaves and later leaves become yellow and wither off.

Control measures:

- Follow wider spacing of plantation (90 cm x 90 cm) or paired row planting system [(90+150) × 60 cm]
- Avoid delayed leaf harvest.
- Spraying 0.2% Kavach (Chlorothalonil 75 % WP) on the leaves
- Safe period: 5 days

1.1.4. Sooty mould: This disease, caused by a group of fungi, is more prevalent during the winter season, usually between August and December. Crop loss ranges from 10-15%. Whiteflies in the mulberry field trigger the disease, as fungi develop on the honey-like substance they produce. Favourable conditions for development include temperatures of 20-24°C and relative humidity levels exceeding 70%.

Symptoms:

- Thick black coating develops on the upper surface of the leaves.

Control measures:

- Spray 0.2% Indofil-M45 to check growth of saprophytic fungi.
- Foliar spray of 0.02% monocrotophos on 15th and 30th day after pruning to control white fly infestation.
- Safe period: 15 days.

1.1.5 Leaf Blight disease: Leaf blight in mulberry is caused by both fungi and bacteria.

1.1.5.1. Fungal leaf blight: The pathogens, *Alternaria alternata* and *Fusarium pallidoroseum*, cause this disease, prevalent during summer and rainy seasons. Crop loss is estimated at 10-12%. Airborne dispersal of fungal spores (conidia) is facilitated by water and wind currents. Favourable conditions for outbreak include temperatures of 25-30°C and humidity levels of 40-60%.

Symptoms:

- The disease starts as browning/ blackening of leaves from tips or margins of leaf. When severe, the entire leaf surface becomes brown and falls.

Control measures:

- Follow wider spacing of plantation or paired row-planting system.
- Spraying 0.2 % Dithane M-45 (Mancozeb 75 % WP) on the leaves.

1.1.5.2. Bacterial leaf blight: The pathogens, *Pseudomonas syringae* and *Xanthomonas campestris*, are accountable for this disease, which is transmitted through both air and soil. It is most prevalent during the rainy and winter seasons, with crop loss typically ranging from 5-10%. Favourable conditions for disease development include elevated temperatures and humidity.

Symptoms:

- Numerous blackish-brown irregular water-soaked patches appear on the leaves resulting in rotting of leaves.

Control measures:

- Follow wider spacing of plantation or paired row planting system.
- Spraying Streptomycin (0.2%) or Dithane M-45 (0.2%) on the leaves.

1.2. ROOT DISEASES

Root diseases pose significant challenges to mulberry cultivation in both standing crops and nursery plantations. These diseases, caused by soil-borne pathogens, impair the root system and overall health of the mulberry plant. Nursery diseases, root knot, root rot and disease complexes are particularly serious, affecting both nursery and established gardens.

1.2.1. Nursery diseases: During stem cutting preparation, wounds serve as entry points for soil-borne pathogens, causing nursery diseases that hinder sprouting and sapling survival, with up to 35% mortality. Rain and irrigation spread the diseases, infecting soil and farm tools. Secondary infestation arises from planting infected cuttings. Optimal conditions for disease development include temperatures of 28-30°C, soil moisture below 40% and pH levels between 5 and 10.

1.2.1.1. Stem canker: It is caused by *Botryodiplodia theobroma* manifested as greenish-black eruptions on cuttings. The bark gets decayed resulting in non-sprouting of cuttings.

1.2.1.2. Cutting rot: It is caused by *Fusarium solani* and appears as rotting of the whole cuttings and decaying of bark resulting in death of the sprouted cuttings.

1.2.1.3. Collar rot: It is caused by *Phoma sorghina* or *P. morourm* and appears as brown to black discoloration of bark and rotting of cuttings near the soil surface line i.e., collar region of cutting.

1.2.1.4. Die-back: is caused by *Botryodiplodia theobromae* and is characterized by the wilting of saplings at the apex and progressing downwards resulting in death of saplings.

Control measures:

- Ploughing the land deeply and (exposing the soil to sunlight for about a month levelling to avoid water logging and keeping the land free from weeds during establishment of the saplings/plants.
- Soaking the cuttings in 0.1% Dithane M-45 solution for half an hour before plantation and planting the soaked cuttings in nursery beds followed by irrigation.

Integrated management: This method entails dipping cuttings in a 0.1% Dithane M-45 solution and applying a bioformulation called Nursery-Guard, produced by CRTI, Mysore, containing *Trichoderma pseudokoningii*. In nursery beds, broadcast 2 kg/m² and mix well in soil. For direct plantation in the main field, apply 50 g/pit before planting.

1.2.2. Root knot: The causal organism, *Meloidogyne incognita*, causes this disease, prevalent year-round, especially in sandy soils under irrigation, leading to a 20% crop loss. Disease transmission occurs primarily through contaminated soil, farm implements and run-off irrigation. Favourable conditions for root knot disease development include temperatures of 27-30°C, soil moisture below 40% and pH levels between 5 and 7.

Symptoms:

- Severely affected mulberry plants show stunted growth with low water moisture in leaves, later yellowing of leaf margins.
- Formation of knots / galls on roots is the main indicator of the disease.
- Galls are spherical and vary in size; young galls are too small and yellowish white in colour; old galls are big and pale brown.

Control measures:

- Summer deep ploughing at 30-40 cm depth reduces nematode populations by exposing eggs and larvae to lethal heat.

- Use disease-free saplings for new plantations; treat them by immersing in hot water at 48°C for 20 minutes before planting.
- Disinfect farm implements with 5% formalin solution or boiling water (5-10 minutes) before use.
- Apply neem oil cake @ 800 kg/acre/year in four split doses near the root zone during intercultural operations.
- Plant marigold (*Tagetes patula*) as an intercrop at 30 cm distance between mulberry rows.
- Apply Furadan (Carbofuran 3 G) at 40 kg/ha/year in four split doses during fertilizer application or cultural operations, ensuring a 40–45-day interval before feeding treated leaves to silkworms.
- Soil application of Bionema (*Verticillium chlamydosporium*) mixed with neem oil cake and FYM (1:24:200) @ 200 g/plant around exposed roots, 3 times/year at 4-month intervals during cultural operations/fertilizer application.

1.2.3 Root rot: The causal organism, *Rhizoctonia bataticola* (*Macrophomina phaseolina*), is associated with secondary microbes like *Fusarium solani*, *F. oxysporum* and *Botryodiplodia theobromae*. It prevails year-round, thriving in low-moisture, low-organic matter soils with temperatures of 28-34°C. Crop loss exceeds 15%, influenced by soil health and climate. Contaminated soil, farm implements and irrigation spread the disease, while diseased saplings and cultivation practices serve as secondary sources of infestation.

Symptoms:

Above ground symptoms of root rot (yellowing/withering of leaves)

- Sudden withering of plants and leaves fall off from the bottom of the branches and progressing upwards.

Below ground symptoms of root rot (rotting of the roots)

- Decaying of root cortex or skin, turn black due to fungal spores/mycelium below the bark.
- The severely affected plants lose the hold in the soil and can be easily uprooted.
- On severity, the entire root system gets decayed and plants die.
- Affected plants after pruning, either fail to sprout or plant sprouted bears small and pale-yellow leaves with rough surface.

Control measures:

- The diseased plants should be uprooted and burnt.
- A target specific new formulation “Navinya” (herbal 80% & chemicals 20%) is used for the control of root rot disease of mulberry.
- Application of Dithane M-45 integrated with biofungicide, Raksha (*Trichoderma harzianum*), Chethak, a newly developed formulation by CSRTI Mysore.
- 10 g of Dithane M-45 / pit should be applied and the new saplings should be planted after soaking in Dithane M-45 (0.1%) solution for 30 minutes.

1.2.4. Root disease complex: The root disease complex, resulting from the interaction between nematode *M. incognita* and root rot fungi like *Fusarium solani*, *F. oxysporum*, *B. theobromae* and *M. phaseolina*, poses a significant challenge in mulberry production. Crop losses of at least 15% are common, varying based on location and disease severity. Spread primarily occurs through contaminated soil, farm implements and runoff irrigation. Secondary sources include infected saplings, intercropping and the growth of susceptible weeds. Favourable conditions for development include temperatures of 20 to 35°C, soil moisture below 40% and pH ranging from 4 to 8.

Symptoms:

- In the initial stages of infection, symptoms include yellowing of leaves, stunted growth, and reduced leaf lamina.

- Pruned plants either fail to sprout or produce small, pale yellow and wrinkled leaves. As the disease progresses, wilting, browning and defoliation of leaves occur from the lower branches upwards, eventually leading to wilting of the entire plant.
- Severe infestation results in patches of wilting across the garden. Decayed roots turn black due to fungal presence, with the entire root system decaying in severe cases, causing plants to easily uproot.
- Severely infested plants may exhibit over 100 galls per plant due to nematode attack, along with decayed roots from fungal attack.

Control measures:

- Bio-mix, when applied with Pongamia oil cake, achieves disease control rates of 75-80%. Its shelf life at room temperature (25-30°C) is one year.
- To prepare the mixture, combine Bio-mix with 10 kg Pongamia oil cake and 50 kg FYM, applying at a rate of 200 g per plant or 1 kg for every 300 plants.
- Apply the mixture three times a year, spaced four months apart, during cultural operations or fertilizer application after leaf harvesting or pruning, followed by irrigation.
- For root system treatment, apply 1.5 g Furadan and 10 g Dithane M-45 per plant, removing soil to a depth of 15 cm.
- Chetak, an herbal formulation developed at CSRTI, Mysuru, combines botanicals (65%) with sublethal doses of chemicals (35%) for controlling major foliar and soilborne diseases of mulberry.

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