

Strawberry diseases: Saving India's Sweet Harvest from Silent Soil Saboteurs

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Abstract

Strawberry cultivation in India, particularly in small hilly regions like Himachal Pradesh, Vizag, Sikkim is expanding but faces significant threats from soil-borne diseases. These diseases, caused by various fungal pathogens, can lead to significant yield losses and economic impact. This article provides a comprehensive overview of common soil-borne diseases affecting strawberries, including Verticillium wilt, Fusarium wilt, Phytophthora root rot, red stele, and black root rot complex. The article delves into the symptoms, etiology, and epidemiology of each disease, highlighting the environmental conditions that favour their development. It also offers a detailed exploration of integrated disease management strategies, encompassing cultural practices, biological control methods, and judicious chemical applications. By understanding the intricacies of these diseases and adopting a multifaceted management approach, strawberry growers can mitigate the impact of soil-borne pathogens and ensure sustainable production in both India and worldwide.

Key words: Strawberry, soil borne diseases, management

Introduction

Strawberries are a cherished fruit globally, prized for their vibrant color, sweet taste, and nutritional value. Worldwide, strawberry cultivation has seen a significant rise, with an estimated production of 9.23 million metric tons in 2021.

India, too, has emerged as a significant player in strawberry production. In 2022, the country produced approximately 179,000 metric tons of strawberries,



cultivated across 4,400 hectares. While this represents a small fraction of global production, it highlights the growing importance of this crop in India's agricultural landscape.

However, strawberry cultivation faces numerous challenges, with soil-borne diseases ranking among the most significant threats to yield and fruit quality. These diseases, caused by various fungal pathogens, can lead to significant economic losses if not adequately managed. In this article, we delve into the most prevalent soil-borne diseases affecting strawberries, exploring their symptoms, etiology, and the environmental conditions that favour their development. We will also provide a comprehensive overview of integrated disease management strategies, equipping growers with the knowledge and tools needed to combat these persistent pathogens and ensure sustainable strawberry production.

However, their production faces numerous challenges, including soil-borne diseases, which can cause substantial yield losses if not adequately managed. Soil-borne pathogens infect roots, crowns, and other below-ground plant parts, leading to various symptoms such as wilting, stunting, root rot, and plant death. The complex nature of these diseases, coupled with limited control options, necessitates a holistic and integrated approach to disease management.

Common Soil-Borne Diseases of Strawberry: A Closer Look

Soil-borne pathogens are a formidable foe for strawberry growers, causing a range of devastating diseases that can significantly impact yield and fruit quality. Understanding the symptoms and etiology of these diseases is crucial for early detection and effective management.

Verticillium Wilt (*Verticillium dahliae*)

- **Symptoms:** Verticillium wilt initially manifests as wilting and yellowing of older leaves, often starting on one side of the plant. As the disease progresses, younger leaves may also become affected, and the plant can exhibit stunting and reduced vigor. In severe cases, the vascular tissue in the crown and roots may show discoloration, and the plant may eventually die.
- **Etiology:** The fungus *Verticillium dahliae* is a soil-borne pathogen that survives for long periods in soil as microsclerotia (resting structures). It infects strawberry plants through the roots, where it colonizes the vascular system, leading to blockage of water and nutrient transport. The disease is favoured by warm temperatures (21-27°C) and can be more severe in stressed plants.

Fusarium Wilt (*Fusarium oxysporum f. sp. fragariae*)

- **Symptoms:** Fusarium wilt also causes wilting and yellowing of leaves, but it typically starts with older leaves and progresses upward. The affected leaves may turn reddish-brown, and the plant can exhibit stunting and root discoloration. In advanced stages, the plant may collapse and die.
- **Etiology:** The fungus *Fusarium oxysporum f. sp. fragariae* is a soil-borne pathogen that infects strawberry roots and colonizes the vascular system. It produces toxins that disrupt water and nutrient transport, leading to wilting and other symptoms. The disease is favoured by warm temperatures (24-30°C) and can be exacerbated by water stress.



Phytophthora Root Rot (*Phytophthora cactorum*, *Phytophthora fragariae*)

- **Symptoms:** Phytophthora root rot causes a general decline in plant health, including wilting, stunting, leaf chlorosis, and reduced fruit production. Infected roots appear brown and rotted, and the plant may eventually collapse.
- **Etiology:** *Phytophthora cactorum* and *Phytophthora fragariae* are oomycete pathogens that thrive in wet soil conditions. They infect strawberry roots, causing root rot and disrupting water and nutrient uptake. The disease is more prevalent in poorly drained soils and during periods of high rainfall or irrigation.



Red Stele (*Phytophthora fragariae*)

- **Symptoms:** Red stele is a specific type of Phytophthora root rot characterized by the presence of red discoloration in the stele (central cylinder) of the roots. Above-ground symptoms include wilting, stunting, and reduced fruit production, similar to general Phytophthora root rot.



- **Etiology:** *Phytophthora fragariae* is the causal agent of red stele. It infects strawberry roots, particularly in cool, wet conditions, and causes root damage that disrupts plant function.

Black Root Rot Complex (*Rhizoctonia solani*, *Pythium* spp.)

- **Symptoms:** Black root rot is a complex disease caused by multiple pathogens, including *Rhizoctonia solani*, *Pythium* spp., and others. Infected roots exhibit black lesions and rotting, leading to reduced plant vigor, stunting, and poor fruit production.
- **Etiology:** The various pathogens involved in black root rot complex thrive in moist soil conditions and infect strawberry roots, causing damage and impairing nutrient uptake.



Disease Epidemiology and Factors Influencing Disease Development

Understanding the epidemiology of soil-borne diseases in strawberries is essential for implementing effective management strategies. Disease epidemiology explores the factors influencing the occurrence, distribution, and spread of these pathogens.

Survival and Spread

Soil-borne pathogens have remarkable survival capabilities, persisting in soil for extended periods, often as resting spores or mycelium. They can infect strawberry plants through several pathways:

- **Root Infection:** This is the most common mode of infection, where pathogens enter the plant through root tips or wounds.
- **Crown Infection:** Pathogens can also infect the crown (the area where the roots meet the stem), particularly in wet conditions or through wounds.
- **Spread through Soil and Water:** Pathogens can be transported through soil by water movement, machinery, or even on tools and footwear.

Favorable Conditions

Several environmental and cultural factors can significantly influence the development and spread of soil-borne diseases in strawberries:

- **Soil Moisture and Drainage:** High soil moisture and poor drainage create an ideal environment for many soil-borne pathogens, particularly oomycetes like *Phytophthora*.
- **Soil Temperature:** Different pathogens have optimal temperature ranges for growth and infection. For example, *Verticillium* wilt thrives in warm temperatures (21-27°C), while red stele is more prevalent in cooler conditions.
- **Soil pH:** Soil pH can affect the availability of nutrients and the activity of certain pathogens. For instance, some fungal pathogens are more aggressive in acidic soils.
- **Crop Rotation:** Continuous cropping of strawberries in the same field can lead to a buildup of pathogen populations in the soil.
- **Plant Stress:** Stressed plants are more susceptible to infection. Factors such as drought, nutrient deficiencies, or other diseases can weaken plants and make them more vulnerable.
- **Cultivar Susceptibility:** Different strawberry cultivars exhibit varying levels of resistance or susceptibility to specific soil-borne pathogens.

Seasonal Variations

The incidence and severity of soil-borne diseases can fluctuate throughout the growing season due to changes in environmental conditions. For example, *Phytophthora* root rot is more prevalent during periods of high rainfall or irrigation, while *Verticillium* wilt may become more problematic as temperatures rise in the summer.

Disease Management Implications

Understanding the epidemiology of soil-borne diseases can inform disease management strategies. By identifying the factors that favour disease development, growers can implement cultural practices, such as improved drainage, crop rotation, and the use of resistant cultivars, to reduce disease risk. Additionally, knowledge of seasonal variations can guide the timing of fungicide applications or other control measures.

By incorporating epidemiological knowledge into their management practices, strawberry growers can better protect their crops from the devastating effects of soil-borne diseases.

Integrated Disease Management Strategies for Soil-Borne Diseases in Strawberry

Effective management of soil-borne diseases in strawberries requires a holistic approach that combines multiple strategies. This integrated approach aims to reduce pathogen populations, enhance plant health, and minimize the risk of disease outbreaks.

Cultural Practices:

Cultural practices are essential for preventing the introduction and spread of soil-borne pathogens. They focus on creating an environment less favourable for disease development and promoting plant health.

- **Crop Rotation:** Avoid planting strawberries in the same field for consecutive years. Rotate with non-host crops like cereals or brassicas to disrupt the pathogen's life cycle and reduce their population in the soil.
- **Resistant Cultivars:** Select strawberry varieties with known resistance or tolerance to specific soil-borne diseases. Consult with local experts or extension services for recommendations on suitable cultivars for your region.
- **Certified Disease-Free Planting Material:** Use certified disease-free transplants to avoid introducing pathogens into your field.
- **Soil Solarization:** In warm climates, solarization can be effective. Cover the soil with clear plastic during the hottest months to raise soil temperature and kill many soil-borne pathogens.
- **Raised Beds and Improved Drainage:** Plant strawberries in raised beds with well-draining soil to minimize water logging and create an environment less conducive to pathogen growth.
- **Sanitation:** Remove and destroy infected plants promptly to prevent the spread of pathogens. Clean tools and equipment between fields to avoid cross-contamination.
- **Nutrient Management:** Maintain optimal soil fertility and avoid excessive nitrogen fertilization, as it can promote lush growth that makes plants more susceptible to some diseases.

Biological Control:

Biological control utilizes beneficial microorganisms to suppress or antagonize soil-borne pathogens.



- **Beneficial Fungi:** Introduce beneficial fungi like *Trichoderma harzianum* or *Trichoderma virens*, which can colonize roots and compete with pathogens for space and nutrients.
- **Beneficial Bacteria:** Certain bacteria, such as *Bacillus subtilis* or *Pseudomonas fluorescens*, can produce antibiotics or enzymes that inhibit pathogen growth. These beneficial bacteria, also known as PGPR (Plant growth promoting rhizobacteria) enhance root and shoot growth besides eliminating harmful pathogens.
- **Organic Amendments:** Incorporating compost, crucifer leaves, neem cake or other organic matter can enhance soil microbial diversity and activity, creating a more suppressive environment for pathogens.

Chemical Control:

Chemical control options include fungicides and fumigants, but their use should be judicious and integrated with other management strategies to avoid resistance development and minimize environmental impact.

- **Fungicides:** Fungicides can be used as a preventive measure before planting or as a curative treatment for existing infections. Choose fungicides with specific activity against the target pathogens and follow label instructions carefully. Fungicide dose should always be adhered.
- **Fumigants:** Soil fumigation can be effective for controlling soil-borne pathogens, but it is a drastic measure with potential negative effects on beneficial soil organisms. It should be used as a last resort and only under professional guidance.

Additional Considerations

- **Early Detection:** Regular scouting and monitoring of plants are crucial for early detection of disease symptoms. This allows for timely intervention and prevents widespread outbreaks.
- **Integrated Pest Management (IPM):** Implement an IPM program that combines cultural, biological, and chemical control methods to manage both diseases and pests in a sustainable manner.
- **Record Keeping:** Keep detailed records of disease incidence, cultural practices, and control measures to track the effectiveness of your management strategies and make informed decisions.



By integrating these various disease management strategies, strawberry growers can create a more resilient and sustainable production system that minimizes losses due to soil-borne diseases.

