EPRA International Journal of Agriculture and Rural Economic Research (ARER)- Peer-Reviewed Journal
Volume: 13 | Issue: 5 | May 2025 | Journal DOI: 10.36713/epra0813| Impact Factor SJIF(2025): 8.733| ISSN: 2321 – 7847

COMMON DISEASES OF COTTON AND CONTROL MEASURES

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ABSTRACT----------
Cotton (Gossypium spp.) is one of the most important fiber crops globally, playing a vital role in the agricultural and economic sectors of many countries. However, its production is severely constrained by various diseases that affect plant health, reduce yield, and deteriorate fiber quality. This paper provides a comprehensive overview of the most widespread cotton diseases, including fungal, bacterial, and viral infections, and evaluates scientifically proven control strategies. Among fungal pathogens, Verticillium dahliae and Fusarium oxysporum are recognized for causing wilt diseases that lead to leaf yellowing, vascular blockage, and plant death. Colletotrichum spp. causes anthracnose, leading to necrotic lesions on bolls and stems. Bacterial blight, caused by Xanthomonas campestris pv. malvacearum, manifests as water-soaked lesions and severely affects crop growth and productivity. Viral infections such as Cotton Leaf Curl Virus (CLCuV), primarily transmitted by whiteflies, result in leaf deformation, stunting, and severe yield loss. To manage these diseases, a multi-dimensional strategy is essential. Agro-biological methods such as crop rotation, soil sanitation, and the use of disease-resistant cultivars serve as the first line of defense. Chemical treatments using fungicides, bactericides, and insecticides help reduce the disease burden during the crop season. In addition, biological control agents like Trichoderma spp., Bacillus subtilis, and Pasteuria penetrans offer environmentally sustainable alternatives. This review also highlights contributions from international researchers regarding pathogen biology, disease mechanisms, and control innovations. An integrated disease management approach combining prevention, early diagnosis, and targeted intervention is key to sustainable cotton production and global food and fiber security.

KEYWORDS. *Cotton, Plant Pathology, Verticillium Wilt, Fusarium Wilt, Bacterial Blight, Cotton Leaf, Curl, Virus, Disease Management, Biological Control, Fungicides, Integrated Pest Management----------*

INTRODUCTION

Cotton (Gossypium spp.) is one of the most widely cultivated industrial crops in the world and is of crucial socio-economic importance, especially in countries such as India, China, the United States, Pakistan, Brazil, and Uzbekistan. It serves as a major raw material for the global textile industry, providing livelihoods to millions of farmers, textile workers, and trade-related professionals. In Uzbekistan, cotton—often referred to as "white gold"—plays a central role in the national economy, contributing significantly to employment, rural development, and export revenues.

Despite its economic significance, cotton cultivation faces numerous challenges, among which plant diseases are the most destructive biotic stressors. These diseases affect plant growth, reduce fiber quality, and can drastically diminish yield. The most prevalent cotton diseases can be classified into three main categories based on the nature of the pathogens: fungal, bacterial, and viral.

Fungal diseases such as Verticillium wilt and Fusarium wilt are among the most widespread and economically damaging. These soil-borne pathogens invade the vascular system of the plant, leading to internal blockage, wilting, leaf necrosis, and plant death. Colletotrichum spp., the causative agent of anthracnose, attacks bolls and stems, resulting in boll rot and significant yield loss. According to Bell and Wheeler (1986), Verticillium dahliae survives in the soil for several years due to melanin pigments that enhance the fungus's resistance to harsh environmental conditions.

Bacterial blight, primarily caused by Xanthomonas campestris pv. malvacearum, continues to be a severe problem in cotton-producing regions. This pathogen enters the plant through natural openings or wounds and leads to water-soaked lesions, angular leaf spots, and boll damage. Verma (1986) emphasized that this disease can affect cotton at all growth stages, making early intervention crucial to minimizing losses.

Viral diseases, particularly Cotton Leaf Curl Virus (CLCuV), have gained increased attention due to their rapid spread and the lack of direct antiviral treatments. Transmitted primarily by whiteflies (Bemisia tabaci), CLCuV

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causes upward curling of leaves, vein thickening, enations, and general stunting. Briddon and Markham (2000) reported that the virus poses a growing threat in South Asia and Africa, regions with heavy vector populations and limited access to resistant cultivars.

Given the diverse and persistent nature of these diseases, an integrated disease management (IDM) approach has become essential. Such an approach involves the combination of agro-technical practices, including crop rotation and soil disinfection, the use of resistant varieties, biological control agents, and carefully timed applications of chemical treatments. Biological agents like Trichoderma spp. and Bacillus subtilis have shown promising results in reducing pathogen populations in the rhizosphere. Furthermore, the use of environmentally sustainable strategies is gaining prominence due to the negative ecological and health impacts associated with indiscriminate pesticide use.

This paper aims to provide a comprehensive review of the major cotton diseases, their symptoms, causal agents, epidemiology, and most importantly, the modern strategies used for their control. It incorporates findings from international researchers and highlights practical applications relevant to cotton-producing regions, including Uzbekistan. By understanding the pathology and integrated control measures, stakeholders can make informed decisions that ensure both productivity and sustainability in cotton farming.

Table 1.
Major Cotton Diseases and Their Key Symptoms

Disease Name	Pathogen Type	Causal Agent (Pathogen)	Main Symptoms
Verticillium Wilt	Fungal	*Verticillium dahliae*	Yellowing and drying of leaves; wilting and death of upper plant parts
Fusarium Wilt	Fungal	*Fusarium oxysporum*	Leaf wilting; root decay and vascular discoloration
Anthracnose	Fungal	*Colletotrichum* spp.	Black lesions on stems and leaf tissues; necrosis
Bacterial Blight	Bacterial	*Xanthomonas campestris* pv. *malvacearum*	Water-soaked spots on leaves that turn black over time
Cotton Leaf Curl Virus	Viral	*Cotton Leaf Curl Virus* (CLCuV)	Leaf curling, mosaic patterns, growth retardation

Table 2.
Comparison of Control Measures for Cotton Diseases

Control Method	Advantages	Limitations
Agro-technical Measures	Environmentally safe; improves soil health	Requires long-term implementation for noticeable effects
Chemical Treatments	Fast-acting; effective against a wide range of pathogens	May harm the ecosystem; risk of pathogen resistance development
Biological Control	Sustainable and eco-friendly; reduces disease via beneficial microbes	May vary in effectiveness; dependent on environmental conditions
Resistant Varieties	Long-term solution; disease-resistant genetics	Time-consuming development and certification process

DISCUSSION

The evidence reviewed clearly demonstrates that cotton diseases—particularly fungal, bacterial, and viral pathogens—pose a significant threat to yield and fiber quality. Fungal pathogens such as Verticillium dahliae and Fusarium oxysporum are among the most persistent, as they can survive in the soil for many years and act as long-term sources of infection. These pathogens develop rapidly under optimal conditions (25–30°C with high humidity), severely disrupting plant development. Sole reliance on chemical treatments is often insufficient, as they fail to completely eliminate soil-borne pathogens and may lead to environmental degradation and resistance buildup.

Bacterial infections, particularly bacterial blight caused by Xanthomonas campestris pv. malvacearum, can result in up to 70% yield losses if not detected and managed promptly. Viral diseases such as Cotton Leaf Curl Virus (CLCuV), transmitted by whiteflies, are equally destructive, spreading rapidly across fields and causing severe morphological deformities. This highlights the need for entomological control and virus-resistant cultivars as part of the disease management strategy.

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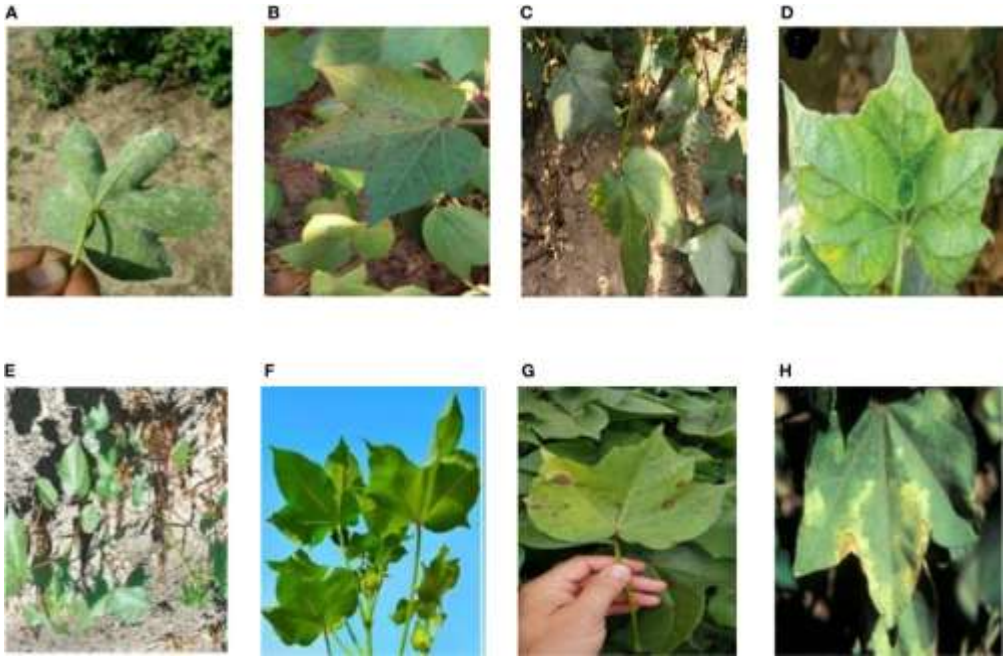

Figure 1 Disease images of cotton set: (A) Areolate mildew, (B) Bacterial blight, (C) Brown spot, (D) Curl virus, (E) Fusarium wilt, (F) Healthy, (G) Target spot, (H) Verticillium wilt. (Dongqin Zhu)

Biological control agents—especially beneficial microbes like Trichoderma and Bacillus species—play a critical role in reducing pathogen populations while promoting soil health. Their application can reduce the dependency on chemical pesticides by 30–40%, leading to more sustainable cotton farming systems. Agro-technical measures such as crop rotation, use of certified seeds, and proper soil preparation are also crucial in minimizing the spread and recurrence of diseases.

In conclusion, no single control method is sufficient on its own. An integrated approach that combines agro-technical, chemical, and biological strategies is the most effective solution for managing cotton diseases. This model ensures sustainable yield, improved fiber quality, and ecological safety, making it a cornerstone of modern cotton production systems.

CONCLUSION

Cotton cultivation is highly vulnerable to a range of diseases, including fungal infections such as Verticillium and Fusarium wilt, bacterial blight, and viral diseases like Cotton Leaf Curl Virus. These diseases not only reduce crop yield but also degrade fiber quality, impacting the overall economic value of cotton. The findings highlight that a single method of control—whether chemical, biological, or agro-technical—is not sufficient on its own. An integrated disease management (IDM) approach that combines disease-resistant cultivars, proper crop rotation, soil preparation, the use of biological control agents, and targeted chemical applications is the most effective strategy. This multifaceted approach ensures better disease suppression, minimizes environmental risks, and contributes to sustainable cotton production. Moving forward, increased emphasis on research, farmer education, and early detection will be critical to managing disease pressures in a changing climate.

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