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Bacterial blight of pomegranate: New perspective and strategies for management in North Western Himalayas

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Abstract

Bacterial blight is one of the most serious problems affecting pomegranate crops, especially in India over the past 20 years. Researchers have been studying this disease since it first appeared in 1952. The disease shows up as many small, separate, sunken, discolored, and water-soaked spots on the fruit. It tends to persist in mild to moderate form throughout the year when temperatures are between 20 and 43°C from April to July, and becomes more severe during the rainy season when humidity is high (over 80%) and temperatures are moderate (25–35°C). No pomegranate genotypes have shown resistance to bacterial blight, though some are moderately susceptible. The disease is managed using physical and chemical methods, as well as by planting resistant cultivars. Bacterial blight poses a major threat to pomegranate farming in the north-western Himalayan region, leading to significant economic losses both domestically and in export markets. Current management includes using disease-free planting material, maintaining good sanitation, and spraying streptomycin (500 ppm) with copper oxychloride. In the future, developing resistant varieties through genetic engineering may offer better control.

Introduction

Pomegranate (*Punica granatum* L.) is a major fruit crop grown widely in tropical and subtropical regions. It is valued for its antioxidants, vitamins, minerals, and other phytochemicals that benefit human health (Zhang et al.,2025). However, pomegranate farming faces many challenges, especially from diseases like bacterial blight. This disease can greatly reduce fruit yield and quality, and it may also shorten the productive life of orchards (Sharma et al.,2017). Bacterial blight can lower pomegranate yields by 30–50%. The disease is caused by the bacterium *Xanthomonas axonopodis*pv. *punicae* (Xap), which enters the plant through wounds and stomata, affecting leaves, stems, and fruits. Warm weather, high humidity, and frequent rain help the disease spread. The pathogen moves quickly through wind, rain splash, insects, contaminated tools, and infected planting material. In India, most pomegranate is grown in tropical and subtropical areas, and the country produces nearly half of the world's total crop (Karan et al., 2022). In 2024-2025, pomegranate was grown on about 132 thousand

hectares in India, with an annual production of 1,357 thousand metric tons.

Despite its economic importance, pomegranate production is affected by several abiotic and biotic stresses, including unfavourable climatic conditions, nutrient imbalances, and diseases caused by fungi and bacteria. Among these, bacterial and fungal diseases are particularly destructive because they lead to severe yield and quality losses. Bacterial blight is considered one of the most damaging diseases, causing losses of up to 60–80%. The disease has also been reported in Pakistan, where it has resulted in significant crop damage (Priya et al.,2024**)**.

The disease was first identified in Delhi in 1952. The causal organism infects all above-ground parts of the plant, and severe infections lead to deep fruit cracking and splitting of the rind, making fruits unmarketable. In recent years, the disease has occurred in epidemic form in major pomegranate-growing states of India, especially in Northern Himalya (Saini et al.,2024**)**. The pathogen responsible for the disease, *Xanthomonas axonopodis*pv. punicae, is a gram-negative, rod-shaped bacterium that forms light yellow, circular, smooth, and convex colonies. The bacterium can survive in soil for more than 120 days and also persists in fallen leaves during the off-season. Environmental conditions such as high temperature and low humidity favor the development and spread of the disease (Fiyaz et al.,2022).

In Northern India, bacterial blight has a severe impact on pomegranate cultivation, causing losses of about 30–50%. It also affects nearly 50% of the people in the region who are directly or indirectly dependent on pomegranate farming for their daily livelihood and income. It can infect the crop from the very early stages of growth and continue until the final stage of fruit development. The disease affects both the leaves and fruits from the initial stage, resulting in significant losses in pomegranate production (Sharma et al.,2024**)**. Over the last two decades, the impact of bacterial blight on pomegranate cultivation has increased every year. This disease has become a major threat to pomegranate farming, causing serious damage to crop yield and productivity.

Symptom

Symptoms of the disease usually appear within 2–3 days after infection. The initial signs include small, yellowish, water-soaked circular spots on different parts of the plant. As the disease progresses, these spots enlarge into irregular lesions, and their centers become dark brown and necrotic. Under severe infection, premature leaf fall may occur. The pathogen can also cause girdling and cracking of stems and branches, while advanced stages lead to extensive necrosis of leaves and twigs. Infected fruits commonly develop cracks or splits, eventually turning dark and shriveled. The plant remains susceptible to infection throughout all stages of growth (Surbhi et al.,2023**)**.

On leaves, tiny water-soaked lesions first appear and later become brown, necrotic spots. These lesions may merge together, forming larger infected areas. Severe infections result in yellowing and shedding of leaves, leading to defoliation. Twigs affected by the disease turn brown or black, wilt, and may eventually die back.

Fruits show small, dark, sunken spots on the surface that gradually enlarge and may cover the entire fruit, causing splitting or cracking. The bacterium may also produce gum-like exudates on infected tissues. In addition, infected fruits often exhibit internal discoloration as a result of tissue rotting.

Fig: Symptom of bacterial blight on leaves and fruits.

Causes of Bacterial blight in pomegranate

Bacterial blight of pomegranate becomes particularly destructive during the fruiting stage of the crop. The pathogen is capable of surviving in infected plant residues, soil, and living plant tissues, which helps it persist and spread from season to season.The disease spreads in several ways, Rain splash and irrigation water can transfer the bacterium from infected plant parts to healthy tissues. Entry of the pathogen is often facilitated through natural openings or wounds present on the plant. Contaminated tools, equipment, and the movement of field workers also contribute to short-distance dissemination of the disease (Doddaraju *et al*., 2019). The use of infected planting materials, including seedlings and cuttings, can introduce the bacterium into new orchards and cultivation areas. In addition, insects such as thrips, blister beetles, and whiteflies may aid in transmitting the bacterium from diseased plants to healthy ones during feeding. Environmental conditions also play a crucial role in disease development. High humidity levels above 50%, temperatures ranging between 25–35°C, intermittent rainfall, and cloudy weather create favourable conditions for rapid spread and severe infection.

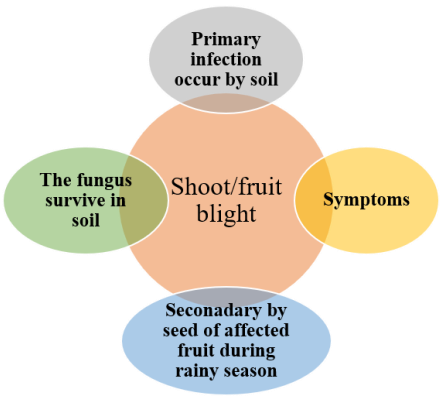
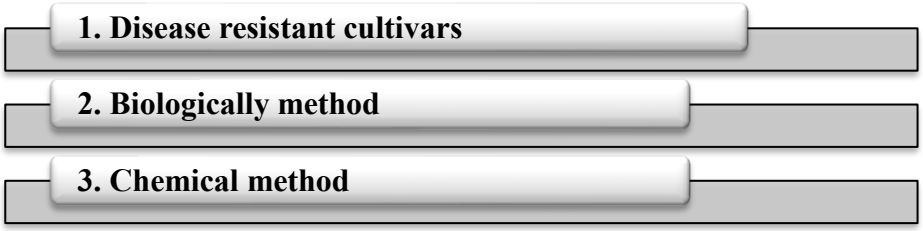


Fig: Disease cycle of bacterial blight

Management of bacterial blight in pomegranate:



For effective management of bacterial blight in pomegranate, use an integrated approach that combines preventive, biological, and chemical methods. Relying only on chemical control is not effective.

Disease-Resistant Cultivars

The cultivation of disease-resistant cultivars is one of the most effective and environmentally sustainable approaches for managing bacterial blight in pomegranate. Host plant resistance minimizes disease incidence, reduces reliance on chemical pesticides, and contributes to long-term orchard productivity. In regions where bacterial blight caused by *Xanthomonas axonopodis* pv. *punicae* is prevalent, the selection of tolerant or resistant cultivars can significantly reduce economic losses.

Among the commercially cultivated pomegranate varieties, **Bhagwa** and **Ganesh** have demonstrated comparatively greater tolerance to bacterial blight than several susceptible cultivars. Bhagwa, a widely cultivated export-oriented cultivar, possesses desirable traits such as attractive fruit color, high yield potential, and relatively lower disease susceptibility. Similarly, Ganesh exhibits moderate resistance and maintains satisfactory fruit production under disease pressure. The use of these cultivars can help limit pathogen establishment and reduce disease spread within orchards.

Biological Control of Bacterial Blight in Pomegranate

Biological control offers an eco-friendly and sustainable approach for managing bacterial blight caused by *Xanthomonas* spp. in pomegranate. The strategy involves the use of antagonistic microorganisms and plant-derived extracts to suppress pathogen growth and reduce disease incidence. Infected pomegranate samples are utilized for pathogen isolation and evaluation of biocontrol efficacy. Botanical extracts such as neem (*Azadirachta indica*), cinnamon (*Cinnamomum verum*), turmeric (*Curcuma longa*), ginger (*Zingiber officinale*), and *Millettia pinnata* possess natural antimicrobial compounds that inhibit the multiplication of the bacterial pathogen. In addition, beneficial microorganisms including *Trichoderma* spp. and *Bacillus* spp. act as biological antagonists through mechanisms such as competition, antibiosis, and induction of plant defense responses. The combined application of these bioagents and botanical extracts can significantly reduce disease severity, improve plant health, and minimize

dependence on chemical bactericides, thereby promoting environmentally sustainable pomegranate production.

3. Chemical method

For the management of bacterial blight of pomegranate caused by *Xanthomonas axonopodis* pv. *punicae*, chemical control remains an important component of an integrated disease management strategy. The disease can be effectively suppressed through the timely application of bactericides and copper-based fungicides. Spraying copper oxychloride (0.25–0.30%) or Bordeaux mixture (1%) helps reduce bacterial multiplication on leaves, twigs, and fruits. Antibiotics such as streptocycline (100–200 ppm) are often used in combination with copper oxychloride to enhance disease control. A commonly recommended spray schedule includes streptocycline (0.05 g L^{-1}) + copper oxychloride (2.5 g L^{-1}) at 10–15 day intervals during periods favorable for disease development. In severely affected orchards, repeated applications may be necessary, particularly during the rainy season when humidity favors pathogen spread. Removal of infected plant parts before chemical application improves treatment effectiveness. Proper coverage of foliage, fruits, and branches is essential for successful disease management. However, excessive reliance on antibiotics should be avoided to minimize the risk of resistance development. Therefore, chemical control should be integrated with cultural and biological practices for sustainable and long-term management of bacterial blight in pomegranate orchards.

Table: Chemical used for bacterial blight management

Product Name	Active Ingredient Composition	Recommended Dose	Citation
Blitox 50 WP	Copper oxychloride 50% WP	2 g per litre of water	Banerjee et al., 2026
Dhanuka Kasu B	Kasugamycin 3% SL	2–3 ml per litre of water	Safdari et al., 2025
Borogold	Nano silver particles combined with peroxy acid	1.5 g per litre of water	Thakur et al., 2020
Crystocycline	Streptomycin sulphate 90% + Tetracycline hydrochloride 10% SP	0.2 g per litre of water	Gao et.,2024
Kocide	Copper hydroxide 53.8% DF	2 g per litre of water	Gao et al., 2023

Conclusion

Bacterial blight has emerged as one of the most serious challenges in pomegranate cultivation across major growing regions, particularly in the north-western Himalayan belt. The disease has led to substantial economic losses in both domestic and export markets. Estimated annual yield losses were around ₹10,000 million in 2022–2023 and approximately ₹2,000 million in 2024–2025. Effective management of bacterial blight has been achieved through integrated disease management practices. These include the use of disease-free planting material, avoidance of cultivation during the rainy season, and proper field sanitation. In addition, sprays of antibiotics such as streptomycin (500 ppm), either alone or in combination with copper oxychloride (0.2%), applied at 15-day intervals, has been found effective in controlling the disease and improving the yield and quality of fruits. Since no naturally resistant pomegranate varieties are currently available, the development of resistant cultivars through transgenic approaches may play an important role in future disease management strategies.

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