



Grey Mould and Fruit Decay: The Post-Harvest Impact of *Botrytis cinerea*

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Botrytis cinerea, commonly known as grey mould, is a highly destructive fungal pathogen in global agriculture. It causes staggering economic losses, estimated to be in the tens to hundreds of billions of USD annually. As a necrotrophic organism, it derives sustenance by feeding on dead or decaying plant tissue. Despite its seemingly innocuous appearance as harmless fuzz on produce, its global prevalence and immense economic impact are undeniable. This pervasive fungus targets an extensive host range, infecting over 1,000 plant species. Soft fruits like grapes, strawberries, tomatoes, and kiwis are particularly vulnerable to its devastating effects. The fungus exhibits an insidious nature, often initiating invasion during delicate stages such as blooming or early fruit development. It then enters a latent period, remaining dormant within the plant tissue, often unnoticed. This dormancy can persist until harvest or during post-harvest storage. Under favourable conditions—typically warm, moist environments with high humidity—this latency abruptly ends, triggering rapid decay. Spores readily disseminate through wind currents, water droplets (like rain or irrigation), and even direct human contact, facilitating their spread from the farm to the consumer. Grey mould poses a significant and persistent challenge, especially in post-harvest storage and transit, which become critical control points for managing this issue. Consequently, even months of meticulous farming practices can be swiftly undermined by this fungus, with extensive spoilage occurring within a mere few days. Its adaptability and resistance to some fungicides further complicate management strategies.

Mechanisms of Fruit Deterioration by *Botrytis cinerea*

Texture degradation: The most noticeable symptom of *B. cinerea* infection is the softening of fruit tissues. The fungus releases enzymes like pectinases and cellulases that break down cell walls, turning firm fruit into mushy, unappetizing masses.

Visual and Sensory Damage: Infected fruits are covered in greyish mycelium and spores, making them unsightly. This fungal overgrowth often emits a musty odour, further decreasing consumer acceptance.

Nutritional Losses: Studies show that *B. cinerea* infection leads to a reduction in vital nutrients like vitamin C, sugars, and organic acids. This not only lowers the fruit's nutritional value but also its flavour profile.

Secondary Infections and Cross-Contamination: *Botrytis* can predispose fruits to other microbial invasions. One infected fruit in a batch can quickly lead to spoilage of the entire consignment, particularly during long-distance shipping.

Understanding the Pathogen's Lifecycle and Impact:

Necrotrophic Nature: *B. cinerea* is a necrotroph, meaning it actively kills plant cells to extract nutrients. This distinguishes it from biotrophic pathogens that feed on living tissue. It achieves this by producing various virulence factors, including enzymes that degrade plant

cell walls, and even generating reactive oxygen species (ROS), which contribute to host cell death.

Symptoms: Early stages of infection can be subtle and difficult to distinguish from other plant stresses. However, as the disease progresses, characteristic symptoms emerge. These often include water-soaked lesions that expand and turn brownish-grey. The hallmark "grey fuzz" is visible in later stages, representing the abundant conidia produced by the fungus. On fruits, this typically manifests as a soft, brown rot. In grapes, it can cause "bunch rot," where entire clusters decay before ripening.

Insidious Infection Strategy: The fungus often initiates infection during the delicate stages of blooming or early fruit development. What makes it particularly problematic is its ability to then remain quiescent, or dormant, within the plant tissue. Symptoms may not become apparent until harvest or even during post-harvest storage and transit, when conditions become optimal for fungal proliferation. This latent infection can lead to an abrupt onset of decay, effectively undoing months of cultivation efforts within a matter of days.

Survival and Spread: *B. cinerea* is remarkably adaptable, capable of surviving a wide range of temperatures and conditions. It overwinters as mycelia (strands of the fungus) in plant debris or as resilient, hardened structures called sclerotia, which can persist in soil or on host plants. When favourable conditions return—typically warm, moist environments with high humidity or prolonged wetness—these structures sporulate, releasing asexual conidia (spores). These microscopic spores are then efficiently dispersed by wind, splashing water droplets (rain or irrigation), and even human contact, leading to rapid spread within a field or between harvested produce. Wounded or senescent (ageing) plant tissues, such as old flower petals or harvest wounds, provide ideal entry points and nutrient sources for the fungus to establish itself.

Economic Devastation and Control Challenges:

Widespread Crop Losses: Due to its wide host range and its capacity to cause damage both before and after harvest, *Botrytis cinerea* stands out as a major contributor to crop losses and reduced fruit quality across many agricultural systems. This translates to substantial financial losses for farmers, processors, and retailers. Beyond direct crop loss, the fungus can also impact the quality of processed products, such as in winemaking, where the laccase enzyme produced by *Botrytis* can negatively affect wine flavour, colour, and stability.

Post-Harvest Vulnerability: Post-harvest environments, particularly storage facilities and transport vehicles, are prime battlegrounds for grey mould. The often-humid and cooler conditions within these settings can trigger the rapid development of latent infections, leading to extensive spoilage even after meticulous harvesting and handling practices.

Fungicide Resistance: The extensive use of chemical fungicides for *Botrytis* control has unfortunately led to the widespread development of fungicide-resistant strains. This poses a significant challenge to conventional management strategies, necessitating constant research and development of new active ingredients and integrated pest management approaches. Farmers are increasingly relying on cultural practices, biological controls, and resistance management strategies to combat this adaptable pathogen.

Control Measures

Pre-Harvest Practices: Integrated pest management (IPM), proper pruning, and the use of resistant varieties can reduce infection risk in the field.

Ensure Proper Plant Spacing: Maintain adequate spacing between plants to promote better airflow through the canopy, which helps the foliage and fruit dry more quickly, reducing disease risk.

Avoid Excessive Fertilization: Overuse of nitrogen fertilizers can increase the incidence of fruit rot when weather conditions are favourable for the infection. Use a proper fertigation schedule after planting.

Eco-Friendly Disease Management: With increasing restrictions on chemical fungicides, biological control agents such as *Trichoderma spp.* and *Bacillus subtilis* are gaining

popularity. Natural compounds like essential oils and chitosan coatings also show promise in suppressing *B. cinerea*.

Post-Harvest Handling

- **Cold Chain Maintenance:** Proper refrigeration slows down fungal growth.
- **Humidity Control:** Reducing relative humidity during storage inhibits spore germination.
- **Sanitation:** Cleaning containers and storage rooms limits spore spread.

Packaging Innovations: Smart packaging technologies with antimicrobial films can reduce contamination and extend shelf life.

Conclusion

Botrytis cinerea may be microscopic, but its impact on post-harvest fruit quality is monumental. Its ability to survive harsh conditions, rapidly spoil produce, and evade conventional controls makes it a persistent threat. Combating it requires a blend of modern technology, sustainable practices, and vigilant post-harvest care. Ultimately, understanding this "grey mould" is the first step toward reducing waste and ensuring fresh, high-quality fruit for all.

References

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