International Journal of Horticulture, 2026, Vol.16, No.2, 105-121
http://hortherbpublisher.com/index.php/ijh

Review and Progress Open Access

Current Status and Development Trends of Integrated Pest and Disease Management Technologies in Grapevine

Minghua Li [1] ✉, Dandan Huang [2]
1 Biotechnology Research Center, Cuixi Academy of Biotechnology, Zhuji, 311800, China
2 Hainan Institute of Biotechnology, Haikou, 570206, Hainan, China
✉ Corresponding author: minghua.li@cuixi.org
International Journal of Horticulture, 2026, Vol.16, No.2 doi: 10.5376/ijh.2026.16.0010
Received: 12 Feb., 2026
Accepted: 30 Mar., 2026
Published: 28 Apr., 2026

Preferred citation for this article:
Li M.H., and Huang D.D., 2026, Current status and development trends of integrated pest and disease management technologies in grapevine, International Journal of Horticulture, 16(2): 105-121 (doi: 10.5376/ijh.2026.16.0010)

Abstract Grapevine is one of the most important fruit crops worldwide, but diseases such as downy mildew, powdery mildew, and gray mold, together with various insect pests, have long threatened its yield, quality, and the sustainable development of the industry. However, the traditional reliance on frequent chemical control has also led to resistance development, residue contamination, and ecological risks. This study systematically reviews the current status and development trends of integrated pest and disease management technologies in grapevine, with particular emphasis on the synergistic roles of agronomic regulation, biological control, resistant breeding, monitoring and early warning, precision spraying, and smart management. The results indicate that IPM, through threshold-based decision-making, multi-technology integration, and digital support, can reduce pesticide dependence and improve ecological benefits while ensuring yield and quality. Among these approaches, resistant cultivars, microbial and botanical products, decision support systems (DSS), as well as drones and Internet of Things technologies, have shown strong application potential. Overall, grapevine pest and disease management is shifting from chemical-dependent approaches toward precision-based, intelligent, and ecological strategies. This study provides a theoretical basis and practical reference for building a low-input, resilient, and sustainable modern grapevine protection system.
Keywords Grapevine (*Vitis vinifera* L.); Integrated pest and disease management; Integrated control; Biological control; Precision agriculture; Sustainable cultivation

1 Introduction

Grapevine (*Vitis vinifera* L.) is among the most important fruit crops worldwide, underpinning global wine, table grape, raisin, and juice industries and contributing substantially to rural livelihoods, export earnings, and cultural heritage in many regions (Pertot et al., 2017). Viticulture occupies millions of hectares and supports a high-value value chain from production through processing and tourism, making stable yields and consistent quality a strategic economic objective (Van Leeuwen et al., 2024). However, the crop is highly susceptible to a broad spectrum of pathogens and pests—fungi, oomycetes, bacteria, viruses, nematodes, and insects—that damage leaves, shoots, and clusters, with direct consequences for yield, fruit composition, and marketability (Pertot et al., 2017; Gawande and Sherekar, 2024). Downy mildew (*Plasmopara viticola*), powdery mildew (*Erysiphe necator*), Botrytis cinerea gray mold, trunk diseases, and various insect pests remain the major phytosanitary constraints in most viticultural regions and can require numerous interventions each season to maintain quantitative and qualitative standards (Bois et al., 2017; Gawande and Sherekar, 2024; Van Leeuwen et al., 2024). As a result, pest and disease management is central to sustaining the productivity, profitability, and international competitiveness of grape industries.

Modern grape cultivation's heavy reliance on synthetic pesticides has created a series of agronomic, environmental, and social problems. In many regions, fungicides account for the majority of pesticide use in vineyards, and under high disease pressure, 12-15 spray applications are typically required during a single growing season, with the number sometimes reaching 25-30 (Pertot et al., 2017; Mwaka et al., 2024). Intensive or improper pesticide use has been shown to result in toxic residues in grapes, juice, and wine, while also causing soil and water contamination and negatively affecting biodiversity and human health (Mwaka et al., 2024;