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ORIGINAL RESEARCH ARTICLE

Environmental factors affecting *Trichoderma* spp. and their biocontrol potential in post-harvest disease management

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ABSTRACT

Trichoderma species are filamentous fungi inhabiting soil environments and employed in agriculture due to their capacity to enhance plant growth, disease resistance, and tolerance to adverse environmental conditions. This research aimed to examine the influence of NaCl concentration, temperature, pH, and photoperiodicity on the growth of four *Trichoderma* species, and to evaluate the potential of *Trichoderma* spp. as a biological control agent against five post-harvest fungal pathogens under laboratory conditions. Mycelial growth of *Trichoderma* species exhibited a negative correlation with salinity. Maximum growth rates (4.35-4.59 cm) were observed at control salinity (0 µM). Potato Dextrose Agar media consistently supported significantly ($p \leq 0.05$) higher mycelial growth (4.33-4.35 cm) than Malt Extract Agar, Carrot Agar, and Komada for all *Trichoderma* species. The optimal temperature for mycelial growth of *Trichoderma* spp. ranged from 25-30°C, with maximum growth rates of 4.12-4.40 cm. Temperatures below 20°C and above 35°C resulted in substantial growth reduction, demonstrating temperature's critical influence on mycelial development. Besides, the optimal pH for mycelial growth of *Trichoderma* spp. ranged from 5 to 7, with maximum growth rates of 4.12-4.43 cm. Mycelial growth of *Trichoderma* spp. was significantly enhanced under a 12-hour light/dark cycle (4.33-4.43 cm) compared to continuous light (2.24-2.79 cm) and continuous darkness (2.28-2.56 cm) conditions. Therefore, *Trichoderma* spp. treatments significantly inhibited the mycelial growth of five fungal pathogens compared to the control group, among them, *T. koningii* demonstrated the highest level of inhibition, ranging from 0.28 cm (*B. cinerea*) to 1.65 cm (*A. niger*).

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INTRODUCTION

Phytopathogenic fungi constitute a primary etiological factor in crop disease, resulting in substantial reductions in both crop yield and quality (Rhouma *et al.*, 2023a). These impacts pose significant risks to global food security and economic progress. Furthermore, numerous fungal pathogens produce mycotoxins during infection, which present severe hazards to human and animal health (Rhouma *et al.*, 2023b). The evolving global climate and agricultural practices are facilitating the emergence of fungal diseases in novel host organisms and geographical regions (Rhouma *et al.*, 2021). Research into alternative plant disease management strategies, such as biocontrol, has intensified recently (Matrood *et al.*, 2023). The application of antagonistic microorganisms to suppress plant pathogens has emerged as a more environmentally benign alternative to conventional chemical treatments (Rhouma *et al.*, 2023c; Rhouma *et al.*, 2024). Among these, *Trichoderma* spp. have been investigated as a biocontrol agent for various plant pathogens (Hajji-Hedfi *et al.*, 2023a,b). This genus has demonstrated potential as a